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# AEROPLT
# A Versatile General Purpose Plot Program

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## Abstract

AEROPLT is an interactive, user-friendly, general purpose plot code for plotting tabular data from multiple files. This DISSPLA–based code is convenient and easy to use while permitting great flexibility for users who want to customize their plots. A series of questions leads the user through the program and permits a return to specific portions of the code for plot refinement. Multidevice capability permits the user to plot on the terminal, write to a file for hardcopy plots, or do both simultaneously. An easily modified Setup File is used to store the terminal and hardcopy type codes, plot and text dimensions, and default plot specifications. Parameters for individual plots are written to a Restart File which can easily be edited to change subsequent plots. Additional capabilities are: color plots; a convenient method (similar to TEX) to implement all DISSPLA fonts, character sets, and math alphabets; superscripts, subscripts, underline, and italicize; and plots of the results of mathematical functions of the input data.

# Acknowledgments

The authors thank S.G. Beard, 1553, B.F. Blackwell, 1553, and F.G. Blottner, 1556, for their time and effort in using and testing the code, identifying errors, and making recommendations to enhance its capabilities. Their effort has made a significant contribution in the evolution of AEROPLT. In addition, Sam Beard provided extensive help as a peer reviewer by editing the text throughout the preparation of the manuscript. Kenneth Chavez, who also served as a reviewer, first received the report in its nearly completed form; his time, fresh viewpoint, and recommendations are greatly appreciated.

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# 1. Introduction

AEROPLT is a general purpose DISSPLA-based plot code for plotting files of tabular data on VAX computers. Many innovative features of the code enable even the beginning user to obtain plots quickly and easily. The code proceeds through a series of questions and answers—learning a new set of plot commands is not required. All the unique characteristics that define a plot can be saved in a Restart File and plotted again at a later time. This file can be edited to change such items as input file names or plot titles. Nearly every characteristic of the plot can be modified by the user; the default values which are supplied for these characteristics can be modified to control the size and color of plot symbols, lines, text messages, borders, and legend. The size and placement of the plot on the page or terminal screen can also be modified.

Many codes which plot columns of numbers have limited capabilities but contain advantages appealing to those who use and modify them. In a survey during the development of AEROPLT, users delineated the important characteristics and capabilities of a plot code. There was widespread agreement that a plot code must be convenient and easy to use—especially for new users. In addition, many users wanted to control details of the final plot. Nearly all of the user's needs have been met by AEROPLT.

The beginning user may be intimidated by the size of this user's manual, but the best procedure is to make only a few brief references to it and to run the code by answering the questions it asks. A user unfamiliar with AEROPLT should briefly survey the Table of Contents, Sections 2.1.1 and 2.1.2 for the description of the structure of the input files, and the beginning of Section 3.0 for the command to execute the code. Then after becoming experienced with the code the user may want to reference the manual to streamline the plotting sessions (such as obtaining and modifying the Setup File) or to implement more advanced features.

In Section 2 of this report the basic concepts of AEROPLT, such as the input data files, the Setup File, and the Restart File, are introduced and the remaining capabilities are briefly summarized. Section 3 of this report quotes and discusses the questions that AEROPLT asks in order to obtain plots. References are made to the location in subsequent sections where more detailed information is provided. The advanced features are covered in Section 4. The user who wants to exercise control over the plots will want, as a start, to scan the table of contents for this section. Those with problems or those who find they need additional capabilities should carefully review Section 4 and the Setup File. Sample plots and the corresponding Restart Files are presented in Section 5.

# 2. Summary of AEROPLT Features

## 2.1 Input Files

One of the convenient features of AEROPLT is the versatility in handling input data files. Formatted files of tabular data seldom have to be modified to accommodate AEROPLT. Data from different files may be plotted together on the same graph.

Bad data points within a file can be identified by the user so that AEROPLT will ignore (not plot) those points. Any bad data point within a column must be replaced with a minus sign followed by a space (− ). This will preserve the column position of that and the following data points in that row. When AEROPLT locates that identifier in the data, it will substitute a large number (1.0E+30) outside the range of the plot.

### 2.1.1 Structure

AEROPLT will search the file and identify titles or blank lines. Thus, there is no requirement to remove titles or identify them in some special way. To identify titles, the program searches a row at a time for valid numbers and floating point identifiers—"E" for exponential format (as in 1.520E+01) and "D" for double precision. These two letters can be in upper or lower case. A row which contains any other character is considered a title and is skipped when the data are being read. The disadvantage of this method of identifying titles is that files with columns of Hollerith or character identifiers can be plotted only after removing these alpha columns.

Input data must be formatted in columns and rows. Normally, a comma or at least one space is required between adjacent columns. However, since numbers can be signed, a plus or minus sign at the beginning of a number can also abut the number in the column at the left of the sign. For a row to be considered data, there must be at least two columns. In addition, the row must contain more than two digits. For example, a row with " 1.0 4." will be recognized as two columns of data; but "1. 4." will be treated as a title.

The program also examines the first three positions in each row (or line) to differentiate data from carriage control characters. The term "position" is used to identify the position within an 80–column card image or 132–column line of data in contrast to the term "columns" which usually refers to columns of data to be plotted. If Position 1 contains a number, a plus sign (+), or a minus sign (−) and Position 2 contains a blank space, Position 1 of that row is ignored. If Position 3 contains a blank space the first two

positions are ignored. When AEROPLT counts columns of data within a file, the data in the positions which are ignored are not included in the count.

### 2.1.2 Blocks

Input files of column data are organized into groups called "blocks" in order to standardize plotting many diversified file structures. After a file name is entered at the request of AEROPLT, the program will identify the row count of all titles, blank lines, and blocks of data. A block of data consists of continuous rows of column data. A file beginning with title cards and followed by unbroken rows of data contains one block. Any break in the rows of data with one or more titles or blank lines would start a second block of data. The number of columns may be identical or may change from one block to the next. When the information within columns changes (for example, the third column changes from density to Mach number) and no title cards are present, a blank line must be introduced at this point in the data file to create another block. The program will list the row count for the beginning of each block and the number of rows and columns of data within each block.

When plotting from more than one block within a file, the user must specify whether or not the blocks are similar. If the type of data and the column location of the X and Y variables are the same for all blocks being plotted within that file, the blocks are similar. If column locations are not the same among blocks, the blocks are dissimilar and the number of blocks to be plotted must be entered as a *negative* number.

Further discussion of blocks occurs in Section 3.4.3, and a sample file is modified in Section 5.1.1 so that the block structure produces the desired plots.

### 2.1.3 Input Data File Limits

There are limitations on the number and characteristics of the data files which can be read in; there are also limits on data files and other input information which applies to creating a plot. For the majority of plots, these limits are large enough that they do not impose any restrictions on obtaining desired plots. The maximum number of files, blocks per file, columns per block, and data points per column are given in Table 2.1.

Only a limited number of the file quantities read in can be used to generate a plot. The maximum number of these quantities are listed in Table 2.2.

If a block contains more data points than the maximum allowed for one plot (5000), the first 5000 points will be plotted and the remainder will be skipped. The user can enter a blank line within the first 5000 points to create an additional block in order to plot all the data points. The Customize Option (see Section 4.1) will normally be needed to identify both of these blocks with the same symbol, line, and color.

**Table 2.1. Maximum Number of File Quantities Read In for One Plot**

| | Maximum Number Permitted |
|---|---|
| Files | 25 |
| Blocks per File | 200 |
| Columns per Block | 20 |
| Number of Points in Column | Unlimited |

**Table 2.2. Maximum Number of Quantities Permitted in One Plot**

| | Maximum Number Permitted |
|---|---|
| Files | 1 to 25 |
| Total Number of Blocks (From up to 25 Files) | 25 |
| Curves from Each Block | 25 |
| Number of Points per Curve | 5000 |
| User Defined Functions | 40 |

Although 25 curves can be plotted from each of 25 blocks, the typical plot will tend to become cluttered with more than eight curves. The user-defined functions are introduced in Section 2.6 and covered in more detail in Sections 3.4.5, 3.4.6, and 4.3.

## 2.2 Interactive Questions and Answers

One feature which makes this code easy to use is that it proceeds with a series of interactive questions and answers. Thus, it is not necessary to learn a new set of plot commands. Report–quality plots can be obtained quickly; few references to the documentation are needed. After a plot is obtained, it is easy to move around in AEROPLT to modify plot characteristics until the plot is in its final form.

### 2.2.1 Default Values

Nearly every AEROPLT question has a default value which is listed beside the question. To respond to a question with the default value, the user only needs to enter the Return key. This can significantly speed up getting plots, even if the typed responses were fairly brief. To take full advantage of this capability, the default responses supplied

for the first plot should be the correct response most of the time. The user can supply the desired values in the SETUP.PLT File (hereafter referred to as the Setup File)—see Section 2.4.3 for details.

The defaults are updated each time input values are changed by the user. Thus, the defaults always specify the latest status of the plot. Whenever a user returns to a part of the code to change some plot characteristic, the Return key may be used to respond quickly to all other questions with the desired default.

To improve clarity, the default values are not listed in this report when the AEROPLT question is listed in a sentence structure.

### 2.2.2 Concluding Screen Plot

The terminal screen plot will remain on the screen as long as the user needs it. When finished, the user should enter a key (any alphabetic or numeric key) or the space bar. If possible, the C/R should be avoided since it provides two commands (return and line feed) that sometimes causes the first question following the plot (writing a Restart File) to be skipped. The VT100 terminal, however, requires a C/R after entering a key.

### 2.2.3 Plot Control Menu

After all the questions have been asked and the user has concluded viewing the plot, the program returns to the Plot Control Menu. This menu provides the user control over obtaining and modifying plots. The user can move back into a part of the code that will allow changing some plot specification. Nine different sections of AEROPLT can be accessed. In addition, the user can obtain screen plots, write to a file for hardcopy plots, read in a Restart File, or go to the VAX command level at the $ prompt to do such things as a directory search. When finished, the user can exit AEROPLT from this menu. Details are in Section 3.14.

#### a. Skip to the Plot

Once a plot has been concluded, the Plot Control Menu provides the user the opportunity to return to one of nine places in the code in order to modify the plot. Once the changes have been made it is possible to step through all the remaining questions with the Return key—but this would be inconvenient and time consuming. The user can immediately skip to the plot by responding to any question with a semicolon (;).

#### b. Skip to the Menu

After a user has branched back into the code from the Plot Control Menu and made the desired changes to the plot, a return to the Plot Control Menu is possible by

responding to any question with a colon (:). This is convenient if an error has been made in the modification—the user can go to the menu and immediately return to the desired place in the code to correctly modify the plot. The colon may also be used if it is not necessary to view the plot again. The user who is unsure whether to use the semicolon or the colon may want to remember that the skip to the menu, which is seldom used, is more difficult, requiring a shift to obtain the colon.

## 2.3 Terminal and Hardcopy Plots

AEROPLT takes advantage of the power and convenience of multidevice drivers to eliminate the need for an extra computer run just to obtain hardcopy plots. Within the one executable file of AEROPLT are pointers to allow the choice of one of seven terminal devices and at the same time the choice of one of ten hardcopy devices. The user must choose the terminal and hardcopy devices at the beginning of the program. While the code is being run, a number of options are available to the user: at the same time each terminal screen plot is drawn, file FOR088.DAT can be written for hardcopy plots; the user can choose which plots to write to the hardcopy file (screen plots will not be redrawn); or, the Restart File can be read with or without drawing the screen plots. Thus, users are provided considerable flexibility in the choice of screen and hardcopy plots.

### 2.3.1 Terminal VDI Device Codes

AEROPLT, a DISSPLA plot code, is presently linked with seven Virtual Device Interface (VDI) drivers. The device codes for the terminals are listed in Table 2.3. If any user has a terminal which is not listed, contact the authors. Further discussions of terminal device codes are in Sections 3.1.1 and 4.2.

### 2.3.2 Hardcopy VDI Device Codes

Ten hardcopy device codes appear in Table 2.4. The device driver code for the hardcopy device is listed with the appropriate print command. The print command for device codes QMS, TAL, and T4A are for Department 1550 only. The device driver (code T4A) for the Tektronix 4693DS color plotter is now a multidevice driver, and the output will be written to FOR088.DAT, as are most of the other hardcopy output files. The BTK device allows plots which are incorporated into TEX documents to be viewed on the Talaris 7800 Terminals. Space is reserved on the page, but the plot does not appear when driver QMS is used. The metafile (MET) output to FOR055.DAT can be postprocessed with all terminal (plots will be written to the terminal screen) and hardcopy (file FOR077.DAT will be written) VDI device driver codes. Further discussions of hardcopy device codes are in Sections 3.1.2 and 4.2.

**Table 2.3. VDI Terminal Device Codes**

| Device Driver Code | Terminal | Alpha/Graph Code |
|---|---|---|
| LS5 | Envision 220 | L |
| LS5 | Lear Siegler 7105 | L |
| RET | Retrographics | R |
| TEK | Tektronix 4010 | S |
| TEK | Tektronix 4012 | S |
| TK4 | Selanar | S |
| TK4 | Talaris 7800 | S |
| TK4 | Tektronix 4014 | S |
| T05 | Tektronix 4105 | S |
| T07 | GraphOn 407 | N |
| T07 | Tektronix 4107 | N |
| V34 | Digital VT340 | S |

**Table 2.4. VDI Hardcopy Device Codes**

| Device Driver Code | Hardcopy Device | Print Commands |
|---|---|---|
| BTK | Merge into TEX File | |
| QMS | Talaris 800 or 1200 | FGRAF/PASSALL FOR088.DAT<br>TGRAF/PASSALL FOR088.DAT<br>RGRAF/PASSALL FOR088.DAT |
| TAL | Talaris 1590 | ZGRAF/PASSALL FOR088.DAT |
| T4A | Tektronix 4693DS | TKGRAF FOR088.DAT |
| 24L | Dicomed 24X Fiche | ONODE QUEUE FOR088.DAT TITLE=<br>FICHE TITLE JOBCOM=MY JOBID |
| 48L | Dicomed 48X Fiche | ONODE QUEUE FOR088.DAT TITLE=<br>FICHE TITLE JOBCOM=MY JOBID |
| 35B | Dicomed Black/White Slides | ONODE QUEUE FOR088.DAT<br>JOBCOM=MY JOBID |
| 35C | Dicomed Color Slides | ONODE QUEUE FOR088.DAT<br>JOBCOM=MY JOBID |
| I30 | Imagen Laser Printer | |
| MET | Metafile | POST FOR055.DAT QMS (any VDI Code) |

## 2.4 Setup File

The Setup File, listed in Table 2.5, provides user control over the process of obtaining plots and the details and appearance of the final plot. However, this file is not required because default values are supplied within the program for all items normally read from the file. The users who want the file should go to their VAX home directory and copy:

**COPY LIBDISK:[1630.1636]SETUP.PLT ***

AEROPLT, at the beginning of a session, will search for the Setup File in the user's directory and if it can not locate it there, will search four levels up the directory tree and then in the user's home directory. Some users will find that, in addition to the copy in the home directory, it will be helpful to have copies in subdirectories where plots can be tailored to meet specific needs.

A listing of the Setup File obtained with the above COPY command is in Table 2.5. The first 49 positions in each row of the Setup File contain identification information for that parameter. AEROPLT reads the data beginning in Position 50. The basic categories of information provided by the Setup File are discussed in the following paragraphs.

### 2.4.1 VDI Device Codes

The first three lines of the Setup File are related to the Virtual Device Interface (VDI) drivers. A letter—R, L, S, P, or N—may be entered on the first line to specify the escape sequences required to switch the terminal between alpha and graphics mode. Normally, however, this first line (Position 50, that is) should be left blank as the program will assign the proper letter for the terminal specified by the user. Column 3 in Table 2.3 lists the letter which the program assigns for each terminal type. However, the user may enter one of these letters to override the program's default value. Code "N" specifies that no escape sequences are used, usually requiring a user to move manually between the alpha and graphics mode.

Line 2 specifies the device code from Table 2.3 for the user's terminal (Positions 50-52). If this field is left blank in the Setup File, AEROPLT will list all the available device codes and ask the user to enter the correct code. This is recommended for those who use more than one type of terminal.

If one hardcopy device is used most of the time, the code for that device should be entered on Line 3 of the Setup File; otherwise, Line 3 should be left blank if different hardcopy devices are used with different runs.

## Table 2.5. Setup.plt File

```
 1  Alpha/Graphics Screen(R,L,S,N,P). OK if Blank..
 2  VDI Terminal Device Driver Code..(RET,TK4...)..
 3  VDI Hardcopy Device Driver Code (TAL,QMS...)...
 4      PLOT DIMENSIONS  (inches)
 5  Multiplier to ALL dimensions .................1.0
 6  Multiplier to Character Heights ..............1.0
 7  Multiplier to Symbol size ....................1.0
 8  X page length (Landscape value, Portrait value)10.0, 7.5
 9  Y page length (Landscape value, Portrait value)7.5, 10.0
10  X axis length (Landscape value, Portrait value)7.0,  5.0
11  Y axis length (Landscape value, Portrait value)5.0,  7.0
12  X distance to origin on page:Landscape,Portrait2.0,  1.9
13  Y distance to origin on page:Landscape,Portrait1.2,  1.4
14  Character height of the labels ...............0.20
15  Character height of the first title ..........0.27
16  Character height of the second title .........0.20
17  Character height of the third title ..........0.13
18  Character height of the footer ...............0.13
19  Character height of the footnote .............0.09
20  Character height of the legend ...............0.13
21  Character height of the additional labels .....0.13
22  Curve width.(Suggested:.0125; .001 for spikes).0.001
23  Grid line width ..............................0.005
24  Length of curve ID line in the legend .........0.52
25  Buffer distance used in the legend ............0.09
26  Buffer distance around the additional labels ..0.05
27  Vertical adjustment of plot for footer ........0.65
28  Outside tick marks when no grid exists ........Y
29  Arrowhead for additional labels--4 Digits......1201
30 DEFAULT RESPONSES TO AEROPLT QUESTIONS
31  are entered beginning in (Column) Position 50.
32  When a slash (/) is in Position 51, (only 6 cases):
33   Enter Y or N in 50 for desired default response,
34   Enter a Y in Col. 52 and the question will be asked.
35   Enter an N and it will not be asked.
36  Do you want to read brief Introduction?........Y/N
37  Do you want color plots?.....................N/Y
```

Table 2.5 **Cont.—Setup.plt File**

```
38  Hardcopy output (to FOR088.DAT) for all plots?.Y
39  Plot from a Restart file? .....N
40  Restart file name .....INPUT.RST
41  While reading Restart file, plot on screen.....Y/Y
42  Landscape Orientation? .....Y/N
43  Another plot after the first one? .....1
44  Data file name .....FOR001.DAT
45  Number of files to be read .....1
46  Number of blocks of data from first file.....1
47  First block in file to be plotted .....1
48  Number of curves from the first block .....1
49  X column number.....1
50  First Y column number.....2
51  Second Y column number.....3
52  Type of Graph (Linear,semilog,log-log).....1
53  Type of curve identification (Symbols,lines)...1
54  Color curve identification (1,2,3 Background)..2
55  Color curve identification  Mapper Index.....207
56  Type of grid .....3
57  Whole log cycles? .....Y/N
58  Spline fit the data? .....N/Y
59  Font number .....4
60  X label .....X
61  Y label .....Y
62  Number of titles .....1
63  Legend? .....Y
64  Legend title .....LEGEND
65  Footnote? .....N
66  Footnote .....
67  Number of plot symbols (1-17) Default 9.....0
68  Restart File Written to next version option?...N
```

### 2.4.2 Plot Dimensions

Lines 5 to 29 under the "Plot Dimensions" title provide recommended values for most of the plot characteristics. An examination of these items reveals the power available to the user to control the size of the plot, labels, and titles. Further discussion of this capability appears under the Advanced Features, Section 4.4, and a plot with the size of the symbols increased appears in Section 5.1.3.

### 2.4.3 Default Responses to AEROPLT Questions

The default responses, which are supplied for nearly all AEROPLT questions, are listed in Lines 36-68. Lines 30-35 provide a brief discussion of these fields. The "Y" (yes) or "N" (no) responses to questions are entered in Position 50. Variables, which are entered as integer values, and character strings, such as titles and file names, are entered beginning in Position 50. When a new plot is being developed, these are the responses which will appear in parenthesis after the question and will be supplied to the program if the user responds with only a Carriage Return (C/R). These default responses aid the user not only by enabling a C/R response to the questions but by supplying values for those plot characteristics not included in a Restart File and for those questions skipped when the user branches to the plot with a semicolon or to the Plot Control Menu with a colon.

#### a. Tailor Default Responses to User Needs

The values supplied in the default version of the Setup File are those considered most likely to meet the needs of the typical user. However, after users have some experience with AEROPLT, it is recommended they update the responses in these lines in their copy of the Setup File to reflect the responses they expect to use most of the time. This will increase the speed of stepping through AEROPLT.

#### b. Turn Off Questions

Six questions can be turned on or off from within the Setup File. If any of these questions are off, AEROPLT will skip the question and use the default value supplied. These six questions are identified by a slash (/) in Position 51. The question will be asked when a "Y" is in Position 52; it will be skipped when an "N" appears there. For example, if a user is not interested in the spline fit option (or is always interested), there is no need for the question to be asked on each plot. The program will use the default response provided in Position 50 to determine how to proceed.

## 2.5 Restart File

Those variables that define the plot characteristics can be saved in a Restart File. This powerful feature permits the user to continue working on a plot at a later time (instead of starting over) regardless of whether it is the next day or months later. Sometimes a series of plots are desired. The specifications for a number of plots can easily be combined in one Setup File (hereafter, each of these plot specifications will be called a plot set). It may be that a certain analysis requires a series of related plots which are best grouped in one Setup File. Hardcopy plots are easily obtained by entering the file name into AEROPLT. Later, with new data, the file could be edited, the input data file names changed, and hardcopy plots for the new data obtained.

The Restart File is discussed further in Section 3.2. A typical Restart File is shown in Table 5.3 which contains two data sets. The last line of the data set for each plot contains a long string of asterisks. A "Y" in Position 2 of this line indicates another data set follows, and an "N" indicates that no more data sets follow.

A Restart File plot can be altered if some characteristic not in the Restart File were modified in the Setup File. A complete description of the location of the variables within the Restart File is covered in Section 4.6.2 under the Advanced Features.

## 2.6 Synopsis of Remaining Features

The remaining significant capabilities of AEROPLT follow:

- **Fonts and Character Sets** — All DISSPLA fonts, character sets, and math alphabets are available when entering labels and titles. Superscript, subscript, and underline are also available. Some of the features with the convenience of TEX are implemented which makes accessing these fonts and other characteristics particularly easy to use.
- **Cubic Splines** — A cubic spline interpolation curve may be drawn through the data points.
- **Functions** — Equations, specified like FORTRAN expressions, can be input to convert units or define a mathematical relationship among columns of data in a file. These computed values are then plotted.
- **Legend** — A legend is available to assign a brief descriptive text message to each curve.
- **Additional Labels and Arrows**— Labels can be placed near curves. Arrows may be used to further clarify the label/curve relationship.

- **Color Plots** — Color plots are available with color terminals, the Tektronix 4693DS hardcopy plotter (device code T4A), and Dicomed 35 mm color slides (device code 35C). Three choices are available for background colors, and the eight DISSPLA colors are available for the curves.

- **Curve Identification** — The user can specify an option for the program to identify the curves, or the user can choose to identify the curves by selecting the Customize Option. The program provides a default of nine symbols, eight lines, and eight colors; a number of options for cycling through these identifiers is available. By modifying the Setup File, the user can specify from 1 to 17 different symbols which the program can use.

# 3. Executing AEROPLT

To execute this code on the 1500 VAX Cluster, at the $ prompt enter:

$ AEROPLT

At the beginning of the execution of AEROPLT, default values are assigned and the Setup File, if it can be located in a user's directory, will be read. After the welcome message appears, there is a pause while the plotting package is initialized. All of the questions which the program asks are discussed in this section. The complete discussion of some of the features are deferred (and referenced) to Section 4.

The complete directory information for the SETUP.PLT file which AEROPLT reads is listed first. Thus, users who have Setup Files in different directories will know which one was used. However, if a Setup File could not be located then *Was unable to find a SETUP.PLT file* is listed instead. Normally, the file is read without incident; but if an obsolete version of this file were available or if an extra line were added or deleted in error, the program would probably detect the error and would inform the user: *SETUP.PLT File not in correct format. Failed with Line No. 62. Will use program defaults instead.* The line number which failed would be listed instead of the "62" above. The program would proceed using the default values; afterwards, the user should correct the file or obtain the latest copy (see Section 2.4).

In some circumstances, such as classified plotting, the multidevice capability does not exist. Separate executables are then required for terminal and hardcopy devices. The program looks at the name of the executable and if a valid device name is in Positions 8–10 of the name, it will proceed—recognizing that it does not have multidevice capability. For example, an executable linked with device TAL should be named "AEROPLTTAL". See Section 4.2 for details.

## 3.1 Introductory Questions

These questions are asked only once at the beginning of the program, and no opportunity is provided to change these answers later in the session.

### 3.1.1 Terminal Device Code

If a recognized terminal device code is entered on Line 2 (Position 50-52) of the Setup File, that code will be used and the program will not ask the user for the terminal

device code. Otherwise, the user will be requested to *Enter the device code for your terminal.* The devices in Table 2.3, which AEROPLT recognizes, will be listed on the terminal screen (hereafter described as just "listed" or "displayed").

### 3.1.2 Hardcopy Device Code

If a recognized hardcopy device code is entered on Line 3 of the Setup File, that code will be used and the program will not ask the user for the hardcopy device code. Otherwise, the user will be requested to *Enter correct device code for the hardcopy plots you want.* The devices in Table 2.4, which AEROPLT recognizes, will be displayed.

### 3.1.3 Brief Introduction

The user can specify on Line 36 of the Setup File, which is one of the lines with a slash (/), if the question requesting the Brief Introduction will be asked. A "Y" (Yes) in Position 52 will turn the question on and an "N" (No) will turn it off. If the question is not asked, then the "Y" or "N" in Position 50 will specify whether or not to list the Brief Introduction. This same concept applies to the other five cases with a slash in Position 51. In the following paragraphs, the statement, *If requested by Line n of the Setup File,...*, implies the question is controlled by Position 52 of that line of the Setup File.

If requested by Line 36 of the Setup File, the program will ask: *Do you want to read the brief introduction to this program?* This introductory statement explains the use of a semicolon (;) for branching to the end of the program for plotting and the use of a colon (:) for branching to the Plot Control Menu.

### 3.1.4 Color Plots

If requested by Line 37 of the Setup File, the program will want to know, *Do you want to process color plots?* If color plots are requested the user will be informed, *AEROPLT will ask questions so color plots can be processed.* A request for color plots will set a flag so that when lines and/or symbols are requested to identify the curves, the color options will also be listed. The color options are:

- **Background Colors** — The three options are black, white, and light blue.
- **Foreground Colors** — The symbols and lines which display the plot data can be plotted in any of the eight DISSPLA colors: blue, cyan, green, yellow, red, magenta, black and white. The background color can not be used as a foreground color and some colors show poorly on certain background colors.

Actually, this request to process color plots only controls whether or not the color options will be listed. When the option is presented to the user to identify the data with color, lines, and symbols (see Section 3.3.2), the color options will not be listed if color plots were not requested; but the user may respond anyway with the color options discussed in Section 3.3.2. In addition, color plots will be obtained from a Restart File specifying color regardless of how this question is answered.

The Setup File supplied for users is set to request the question so that new users will be aware of the color option. They should turn this question off if they do not plan to use color. The default for listing the color options and control over the color plot question are supplied on Line 37 of the Setup File.

### 3.1.5 Hardcopy Plots for All Plots

*Do you want hardcopy plots for ALL Restart File and screen plots?* is the next question asked. This is followed by a discussion of the meaning of an "N" response. A "Y" response writes to the hardcopy file for the duration of that session. All plot sets read from Restart Files and all plots following plot modifications (having branched into the program from the Plot Control Menu) will be written to the hardcopy plot file. A "Y" response is recommended to obtain hardcopy plots of Restart Files with more than one plot set.

An "N" response will not write the Restart File plots to the hardcopy file. However, when modifying plots within the program, users have the option to choose those plots for which they want hardcopies. At any time, users can enter a "10" from the Plot Control Menu to write the latest plot to the hardcopy file without redrawing it on the terminal. The Setup File response for this question is on Line 38.

## 3.2 Plotting from a Restart File

The Restart File was introduced in Section 2.5. The program queries:

*Do you want to plot from a Restart File? (Y)*

*Enter Y (Yes), N (No), or integer (i) to process only plot data set number i.*
*Any additions to Restart File will be placed at the end of the file.*

- *Enter a Y* — The file named in the next question will be read in. All plot sets will be read and if hardcopy plots are requested they will all be written to the hardcopy file. The defaults for the final plot will be stored and the user may begin to modify that final plot.

- *Enter an N* — No Restart File will be read. Users will build their own plots by answering the AEROPLT questions.

- *Enter an Integer* — The user enters an integer to identify a plot set within the Restart file to be modified (entering a large number will skip to the last set in the file). The program skips to the number of the plot set specified by the integer so that the defaults for the requested plot set will be stored and the user may begin to modify that plot. The remaining sets are skipped so that all modified plots will be written at the end of the Restart File. After the desired modifications have been made to the plot data set, the user can easily read the same Restart File, by entering an "11" from the Plot Control Menu, to process a different data set.

  Normally, hardcopy plots should not be requested for all plots since all plots are no longer being read—for example, if a "3" were entered in response to the above question, only the plot for the third set would be obtained. If hardcopy plots are requested, then for this example the program will respond, *Hardcopy plots for all plots is not recommended when reading only one data set in a Restart File. Only data set 3 will be plotted.* The user could obtain the desired hardcopy plots with the corrected Restart File in a later session. The Setup File response for this question is on Line 39.

### 3.2.1 Restart File Name

If the user wants to plot from a Restart File, the program will ask *Enter Restart file name.* The user may enter directory information, if required, as well as the file name. If the user has branched from response "11" of the Plot Control Menu, the previous Restart File, if it existed, will be closed and the new file opened. A default file name can be supplied on Line 40 of the Setup File.

### 3.2.2 Draw Restart Plots on Screen

If requested by Line 41 of the Setup File, this option, *As the Restart File is read, do you want the plots drawn on the screen?*, provides user flexibility. Normally, the plot for each data set of the Restart File would be displayed on the user's terminal screen; however, if many plot sets were within the file and there was no real need to see them, the user could turn off the screen plots. Then, with no screen plots:

1. A counter of the plot sets will be listed on the screen as they are read.

2. Hardcopy plots can be obtained very quickly.

3. If hardcopy plots are not needed, the Restart File will be read in a very brief time.

4. The requested plot set, or the last one in the file, can be viewed by entering a "12" from the Plot Control Menu.

5. At the conclusion of reading the Restart File the message *Screen Plots Restored* is displayed.

The default for plotting or not plotting on the screen while reading the Restart File and control over displaying the question are supplied on Line 41 of the Setup File. If a user always wants screen plots, this question can be turned off.

### 3.2.3 Restart File Read

When a Restart File is read, all the variables which are unique to a plot are read and then processed through AEROPLT—except that no questions are asked. The plots are drawn and after the final plot set is concluded, the user is at the Plot Control Menu so that the final plot can be modified.

If a significant error had been introduced while editing a Restart File, AEROPLT will inform the user and skip to the Plot Control Menu. If interested, the user could attach another Restart File, edit and modify the file which failed, and then proceed with the corrected file. See Section 4.6.1 for more details on determining Restart File errors.

## 3.3 Plot Orientation

If requested by Line 42 of the Setup File, the program asks, *Do you want the plot in Landscape Orientation?* The defaults supplied with the Setup File requests landscape but turns off the question. Most users will want to continue using these settings. Users who desire a portrait plot should see Section 4.5. The plot orientation default and control over the question are supplied on Line 42 of the Setup File.

### 3.3.1 Type of Plot—Linear, Semilog or Log-log

The program asks, *Which type of plot do you want?* Numbers 1 through 4 will specify: 1, linear; 2, X log and Y linear; 3, X linear and Y log; and 4, log-log. Differences in plot scale values among these different options will be discussed later (Section 3.5). The Setup File default response for this question is on Line 52.

#### a. Whole Log Cycles

If requested by Line 57 of the Setup File, the program asks, *Do you want to use whole log cycles?* The defaults supplied with the Setup File requests whole log cycles but

turns off the question. Most users will want to continue using these settings. This option is reserved for those cases when partial log cycles are an asset to the plot. The whole log cycle default and control over the question are supplied on Line 57 of the Setup File.

### 3.3.2 Data Identification—Colors, Lines, Symbols

The data must be identified by lines, symbols, or both in black and white or color. The program asks, *How do you want the data identified?* The response options are: 0, 1, 2, 3 or 4. Options 0 through 3 are automated methods for assigning identifiers to the curves. These numbers define the user's preferred method to identify the data to be plotted. The Customize Option 4 provides the user full freedom to assign lines, symbols, and colors to the data to be plotted—limited to the choices available within the program.

In the discussion below, references are made to assigning the next symbol or line (or both) in the table to the next curve. A listing of the colors available, the Line Types, and Symbol Types are in Table 3.1. The numbers associated with each color, line, or symbol type within the applicable column are used in the Restart File (Section 4.6.2) and with the Customize Option (Section 4.1), but the number in the first column is a counter used in assigning the correct identifier. The color, line, or symbol is assigned to each curve as it is processed by the program. The term "curve" is used for its convenience and because it represents most plotted data. (Certainly there are data files which are not plotted with curves—data distributions where each different type has only one or two points which are plotted with symbols but not curves.) The program processes the first file, the first block, and then plots the X and the first Y column or function requested by the user. The next Y column or function is then processed and assigned the next color, line or symbol; when all are processed, the next block is then processed. Subsequent blocks and files are then processed.

For these identifiers to be meaningful when reading a plot, there must be a correlation between them and a description of the data in a legend on the plot. This discussion, though applicable here, will be deferred until the user is requested to enter labels into the legend which is covered in Section 3.9.

**Table 3.1. Data Identification—Colors, Lines, Symbols**

| No. | Colors | Line Types | Symbol Types |
|---|---|---|---|
| 0 | 0: No Color | 0: No Line | 0: No Symbol |
| 1 | 100: Blue | 10: Solid | 1: Box |
| 2 | 200: Cyan | 20: Dash | 2: Up triangle |
| 3 | 300: Green | 30: Dot | 3: Circle |
| 4 | 400: Yellow | 40: Dash - Dot | 4: Diamond |
| 5 | 500: Red | 50: Long Dash | 5: Down triangle |
| 6 | 600: Magenta | 60: Broken Line | 6: Plus in Circle |
| 7 | 700: Black | 70: Line-1 Dot | 7: Solid Box |
| 8 | 800: White | 80: Line-4 Dots | 8: Solid Circle |
| 9 | | | 9: X in Box |
| 10 | | | A: Plus |
| 11 | | | B: Plus in Diamond |
| 12 | | | C: Asterisk |
| 13 | | | D: 2 Triangles |
| 14 | | | E: X |
| 15 | | | F: Plus in Box |
| 16 | | | G: Triangle in Box |
| 17 | | | H: X in Circle |

The options for identifying the data on a plot follow.

- **Option 0: Symbols only** — A zero will instruct AEROPLT to assign symbols to the plot data. The symbols are shown in Table 3.1. As the program completes one curve and begins processing the next curve, the next symbol in the table is implemented. Nine symbols are available by default for the first nine curves; the 10th curve will use the first symbol which also identified the first curve, the 11th will use the second symbol, etc. Although all data are being plotted, only nine different symbols are being used and only the first nine curves are defined in the legend, if one is requested. When the user is labeling the legend entries, those curves which use duplicate identifiers will be listed on the terminal screen (see Section 3.9). The user will not be alerted to this problem if a legend is not requested. For plots with more than nine curves, the user may want to use both symbols and lines or combine symbols and/or lines with color to provide a unique identification for each curve—see Options 2, 3, and color below.

  A total of 17 symbols are actually available. The user can enter any number 1 through 17 on Line 67 of the Setup File to specify the number of symbols desired. Details are covered in Section 4.1.2, and the symbols are described in Table 3.1 and displayed in the legend of Figure 5.3 on Page 74.

  If a user doesn't like the order which the program uses to choose the symbols as the program steps from curve to curve, then the Customize option should be selected.

  Sometimes the large number of data points will render use of symbols impractical if all points are plotted. The next question following this one provides the option to reduce the number of symbols plotted per curve.

- **Option 1: Lines only** — There are eight different line types which can be used to draw the data curves. The order in which these line types are chosen is fixed in a table. If more than eight curves are in a plot, the line types will be repeated with curve nine again using the line type assigned to the first curve, the 10th curve using the same line type as the second, etc. Although all data are being plotted, only eight different line types are being used and only the first eight line types are defined in the legend, if one is requested. When the user is labeling the legend entries, those curves which use duplicate identifiers will be listed on the terminal screen (see Section 3.9). The user will not be alerted to this problem if a legend is not requested. For plots with more than eight curves, the user may want to use both symbols and lines or combine symbols and/or lines with color to provide a unique identification for each curve—see Options 2, 3, and color below. Details are covered in Section 4.1.2, and the lines are described in Table 3.1 and displayed in the legend of Figure 5.2 on Page 69.

  If a user doesn't like the order which the program uses to choose the line types as the program steps from curve to curve, then the Customize Option 4 should be selected.

- **Option 2: Symbols and Lines** — This option combines both symbols and lines to provide a unique identification for a large number of curves. The first curve will be identified by the first symbol and the first line type in the table discussed previously for Options 0 and 1. The program will step through the nine default value symbols for the first nine curves to be plotted. Then the line type will be changed and the same nine symbols will be stepped through again. Of course, if the default value were changed by entering a number 1 through 17 on Line 67 of the Setup File, then that many symbols would be stepped through before the line type would change. This capability could be used to help clarify the data. If three symbols were specified, for example, and there were three Mach numbers, then a symbol would identify a Mach number and the line type would specify some other characteristic.

- **Option 3: Lines and Symbols** — This option combines both symbols and lines to provide a unique identification for a large number of curves. The first curve will be identified by the first symbol and the first line type in the table discussed previously for Options 0 and 1. The program will step through the eight line types for the first eight curves to be plotted. Then the symbol will be changed and the same eight line types will be stepped through again. This will be repeated until all data curves are defined.

- **Option 4: Customize** — The user who chooses the Customize Option 4 can specify the desired symbol and/or line in black and white or color to identify each curve of the plot. This advanced capability will be discussed in Section 4.1.

- **Color** — If color plots have been requested (Section 3.1.4) the user must choose the background color from the options listed on the terminal screen. The color background request is included in the same question with the line/symbol request because they are interrelated. The choice of symbols/lines should be considered differently when they are in color. Normally, symbols or symbols and lines should be used with color instead of only lines because they stand out better and the differences between colors (say blue and green) are more apparent. Of course, if there are many data points, then lines would be needed and should still show well. Another option, if lines were preferred, would be to thicken the lines (Section 4.4.4).

  Once the user has defined the background color, the program will specify the foreground colors for the titles and lines and/or symbols. Three of the color options, 1, 2, or 3, must be multiplied by one hundred and added to the symbol/line options. This information is summarized for these color options in Table 3.2.

  The four columns of Table 3.2 (starting with the second row in the title) will be discussed:

*Column 1:* The first column lists the three options for background color. The light blue is recommended for vugraphs or color slides.

**Table 3.2. Color Plots**

| Background | User Response | Foreground | | | | |
|---|---|---|---|---|---|---|
| Color | Lines/Symbol | Labels, | Color of 4 Curves | | | |
| Option | Option 2 | Titles | 1 | 2 | 3 | 4 |
| 1 Black | 102 | White | Red | Cyan | Yellow | Green |
| 2 White | 202 | Black | Red | Cyan | Green | Blue |
| 3 Light Blue | 302 | Black | Red | Blue | Green | Yellow |

*Column 2:* The second column assumes a user choice of 2 for the symbol and line option. The requirement to multiply the background color option by 100 and add to the symbol/line option is illustrated in this column—the user response is listed for the three background choices. The symbol and line choice of 2 is recommended for color. All curves would be drawn with a solid line (first in the table of lines), and the symbol would be a solid box (7th in the table of symbols—solid symbols are better for color) for the first four curves. After the first four curves are assigned different colors, the symbol would change to a solid circle and the same four colors would be assigned to the next four curves.

*Column 3:* The color of the labels, titles, and legends are listed in Column 3 for each background color.

*Column 4:* A different color will be assigned to each of the first four curves. Then the symbol or line (symbol in this example) would be changed, and the next four curves would be assigned the same four colors. This would continue until all curves are defined. Some colors do not show up well against certain background colors. The program has defined the four colors which are assigned to each of the background colors—they are listed under Column 4.

A fourth background option, 4, lets the program use the default value. Line 54 of the Setup File provides the default background color option. If a number 1, 2, or 3 is not supplied, the background color defaults to black.

### 3.3.3 Thinning Symbols

If symbols have been requested in the previous question (Options 0, 2, or 3), the option to thin is offered with *Enter an "n" to plot a symbol every n-th data point for all curves.* If a 5 were entered by a user, a symbol would be plotted at every fifth data point. If lines were also requested, a line would be drawn through all the data points. Entering a value of 1 would provide a symbol at every data point. A very large number (larger than the number of points in the curve) would provide a symbol only at the endpoints

of the line of data as long as they are within the plot limits. The maximum value which may be entered is "999".

### 3.3.4 Define Grid

The program wants to know *Which type of grid do you want?* The options available are: 0 for no grid, 1 for solid grid, 2 for dashed grid, and 3 for dotted grid. The default value is supplied on Line 56 of the Setup File.

### 3.3.5 Spline Fit

If requested by Line 58 of the Setup File and if lines are requested to display the data, the program will ask, *Do you want the data spline fitted?* This option fits a cubic spline interpolation curve through the data points. See plots in Section 5.1.4 for a comparison of plots with linear line segments (Figure 5.4) and a spline fitted curve (Figure 5.5) on Page 76.

## 3.4 Data Files, Blocks, and Columns

### 3.4.1 Files

Next the program will ask, *Enter no. of files from which data will be plotted.* The user can enter up to 25 files. The program will ask for the name of a file and process that data (number of blocks and columns and data identifiers if the Customize option were chosen) before proceeding to the next file. Users unfamiliar with the information under this section may want to review Section 2.1.

### 3.4.2 File Names

The next question asked is *Enter data file name for file ....* After the word "file..." will be a counter of the number of files being processed. The name of the formatted file of tabular data to be plotted must be entered next, and the directory may be supplied, if required.

If the program fails to locate the file, it will provide an error message, **** FILE NOT FOUND ****, and ask for the file name again. When proceeding through the program the first time for a new plot, the program can not move past this point without a file name. The semicolon and colon option to branch to the plot or Plot Control Menu are disabled at this point. Actually, the program must have a data file to read so it can perform all the calculations of an interactive session—only the questions are skipped (the default

values are used) with the colon or semicolon branch. Of course, the user who can not provide a file name can always exit from AEROPLT with a Control-Y.

After the program has read the input data file, the significant information about the file is listed—except when reading a Restart File. First, the number of blocks which are in the file are provided. Next, for each block, the following information about the file is listed:

1. *Counter:* A counter identifies the number of blocks
2. *Number of Rows:* The number of rows in the block are listed. This is actually the number of data points in each column which will be plotted.
3. *Number of Columns:* Number of columns of data which can be plotted. If more columns are requested to be plotted than actually exist, the columns which do exist will be plotted and the others ignored–with no warning message. The user should review the plot carefully to assure all expected data are plotted.
4. *Starts at Line:* The number of the first row of data in the block is listed. Later, a user may want to edit complicated files and use this number to locate a given block to verify that it is indeed the one intended to be plotted.

### 3.4.3 Number of Blocks to Plot

The program asks the user to *Enter: Number of data blocks which you want to plot from this file. If the blocks are NOT similar, enter number of blocks as a negative number.* Note, this is not asking for the number of blocks in the file (this information has just been made available)—this is asking for the number of blocks *to be plotted.* This can be any number from one to the maximum number of blocks in the file.

If the number entered by the user is larger than the number of blocks in the file, the number will be reduced to the number of blocks in the file and a message will be written: **** Number of Similar Blocks is Reduced to* (the number of blocks in the file) ****.*

The question of similar blocks actually relates to the blocks to be plotted. If, for example, even number blocks contained two columns and odd number blocks contained four columns, a request to plot the odd numbered blocks would be considered similar blocks. Another way to determine if a group of blocks (a single block is considered similar) is similar is to consider the next few questions. The following questions will ask the user to identify the column location of the X variable and the Y variable(s). These questions will only be asked once for similar blocks, but for blocks which are not similar they will be asked for each block.

Remember, if the blocks are not similar, the number of blocks must be entered as a *negative* number.

### 3.4.4 Selection of Blocks

Next, the program needs to know *Which data blocks in the file do you want to plot?* The user must list the block (or blocks) to be plotted, using the counter which provides the location of the blocks. For example, if the user asked for three blocks to be plotted out of eight—the first, fifth, and last block—the entry should be, " 1 5 8 ".

### 3.4.5 Column of X Variable

The program will ask *Enter column number of the X variable.* and *Enter 0 (zero) for a function.* Column numbers are counted from left to right, from 1 to "n", where "n" is the maximum number of columns. Where X is considered the independent variable, enter the number of the column of the data to be plotted on the X axis (X-Y plot).

Functions can be entered which can change units or supply some needed algebraic expression to modify the column of data before being plotted. The data file itself is not modified. To request that a function be applied to the X data, enter a 0 (zero). These functions are covered in the Advanced Section 4.3.

The program has no direct way to handle cases where two or more sets of X-Y plots are desired and the columns of the X variables are different for the different plots. Two suggested methods to handle this situation are:

1. The user could request as many more files as there are sets of X-Y plots. The same file name should be supplied for all of them and a different set of X-Y plots requested for each of these files. The program does not know that the file names are the same.

2. If there are enough blocks to permit it (remember, the number of blocks requested is truncated back to the maximum number in the file), request as many more blocks as there are sets of X-Y plots. Then when identifying the blocks to be plotted, enter as many of the same block number as required for the sets of X-Y plots. For example, three sets of X-Y plots in the fifth block (instead of one, as with the previous example) would be specified by "1 5 5 5 8".

### 3.4.6 Column(s) of Y Variable(s)

The program needs the user to *Enter column number(s) of the Y variable(s) to be plotted.* and *Enter 0 (zero) for a function (multiple zero's acceptable).* Column numbers are counted from left to right, from 1 to "n", where "n" is the maximum number of columns. Where Y variables are the dependent variables, enter the number of the column(s) of the data to be plotted on the Y axis (X-Y plot). To plot the data in columns 4 and 5, enter: " 4 5". If column numbers are requested which do not exist in the file,

then no data will be plotted and no warning message listed. The plot should be checked carefully to assure that all desired data was actually plotted.

Functions can be entered which can change units or supply some needed algebraic expression to modify the column(s) of data before being plotted. The data file itself is not modified. To request that a function be applied to the Y data, enter a 0 (zero)—or as many zero's as there are functions to be plotted. To plot columns 4 and 5 and three functions, enter "4 5 0 0 0". Functions are discussed in the Advanced Section 4.3.

### 3.4.7 Customized Curve Identification

Users who have chosen to customize their plots specify the color/line/symbol for all curves within a block, and then the curves for the next block, until curves for all blocks and all files are defined. This feature is discussed in Section 4.1.

## 3.5 Axes Scale Limits

A set of suggested plot axes scale limits are displayed, first for the X–Axis and then for the Y–Axis. The user can modify none (enter only a C/R), some, or all of these values. If a few of the scale values are changed, the following ones not typed in will retain their value. To skip over a value which does not require changing, the user should enter an asterisk (*) for every field skipped, and the value of those variables will remain unchanged. Examples will be shown in the following sections.

The program determines the suggested scale values by searching the data. This is done the first time through the program and any time later that new files or additional curves are added.

### 3.5.1 X–Axis Limits

When the X–Axis is linear (Plot Type 1 or 3) the program displays, for example:

| *Enter* | *Xmin,* | *Xmax* | *Xstep,* | *Xtick* |
|---|---|---|---|---|
| *Default* = | $-2.00E+01$ | *1.50E+01* | *5.00E+00* | *5* |

The values printed out above on the "Default =" line are simply for illustration purposes. The Xmin and Xmax are the minimum and maximum plot limits. The Xstep is the incremental value between grid lines (Grid Types 1, 2, or 3) or between major tick marks when no grid lines (Grid Type 0) are requested. The Xtick value, normally entered as an integer number, is the number of intervals between grid lines or major tick marks. Thus, a Xtick value of 5 will actually have four minor tick marks.

If a user were to modify the data on the "Default =" line above by responding: "* 20., 10. ", the values of the variables would become: Xmin, −20.; Xmax, 20.; Xstep, 10. and Xtick, 5.

When the X–Axis is logarithmic (Plot Type 2 or 4) the program displays, for example:

| *Enter* | *Xmin,* | *Xmax* | *Xgrid,* | *Xtick* |
|---|---|---|---|---|
| *Default =* | *1.00E+00* | *1.00E+03* | *1* | *1* |

*Set "Xgrid = −9" for one grid line per cycle*

Xmin and Xmax are the minimum and maximum scale values, same as the linear plots. Xgrid controls the grid lines, and a value of either 1 or −9 is recommended. A value of 1 provides the standard logarithm grid lines. A value of −9 replaces the lines with tick marks to identify the scale positions. Xtick controls the number of tick marks and should be set to 1 (a value of 2 or 3 clutters the scale with to many tick marks).

To remove the grid lines from the logarithm example above, the user would only need enter: "* * −9" in order to enter a value of −9 into Xgrid.

### 3.5.2 Y–Axis Limits

When the Y–Axis is linear (Plot Type 1 or 2) the program displays, for example:

| *Enter* | *Ymin,* | *Ymax* | *Ystep,* | *Ytick* |
|---|---|---|---|---|
| *Default =* | *0.00E+00* | *1.00E+02* | *2.50E+01* | *5* |

The Y scale variables, Ymin, Ymax, Ystep, and Ytick, have the same meaning as the linear X scale variables and will not be repeated here.

When the Y–Axis is logarithmic (Plot Type 3 or 4) the program displays, for example:

| *Enter* | *Ymin,* | *Ymax* | *Ygrid,* | *Ytick* |
|---|---|---|---|---|
| *Default =* | *1.00E-01* | *1.00E+02* | *1* | *1* |

*Set "Xgrid = −9" for one grid line per cycle*

The Y scale variables, Ymin, Ymax, Ygrid, and Ytick, have the same meaning as the logarithmic X scale variables and will not be repeated here.

## 3.6 Character Fonts

The program asks the user:

*Which character font style do you want?*

| | | |
|---|---|---|
| *1 : Cartog* | *6 : Triplx* | *11 : Logo1* |
| *2 : Simplx* | *7 : Gothic* | *12 : Swissl* |
| *3 : Scmplx* | *8 : Futura* | *13 : Swissm* |
| *4 : Complx* | *9 : Serif* | *14 : Swissb* |
| *5 : Duplx* | *10 : Fashon* | |

Simply enter the number to request the desired font for the plot text. All fonts available in DISSPLA are available with AEROPLT. Special text commands can change fonts or alphabets for character strings within a label, title, or legend; the capability for subscript, superscript, underline, italicize, and Greek characters are also available. The discussion of these commands, which are covered in more detail in Section 4.7, includes a sample of each of the above character font styles in Table 4.3 on Page 63.

Complx, 4, is the recommended font for most plots. Text in that font are clear and are drawn quickly—a desirable feature when making many plots on the screen while refining a plot into its final form. In order to obtain many hardcopy plots with a font such as Triplx which is slower to draw—and yet save time—a user could develop the plots in Complx and write a Restart File of all the plot sets. The Restart File could easily be edited to change all the 4's to 6's (Col. 23-25 on first line of each data set). Then when the modified Restart File is read into AEROPLT, the terminal screen could be turned off while the hardcopy file is being written. Thus, plots with Triplx font can be obtained quickly. The Setup File default value is on Line 59.

## 3.7 Axes Labels

The data being plotted should be concisely identified by the axis labels. The font has already been specified, but great flexibility is available in writing labels. Special text commands can change fonts or alphabets for character strings within the label; the capability for subscript, superscript, underline, italicize, and Greek characters are also available. The details are in Section 4.7.

### 3.7.1 X–Axis Label

The program asks:

*Enter X axis label*
*Default = Your X Label*

The X label from Line 60 of Setup File will be entered on the line with the "*Default =*" statement the first time through with a new plot. The user should enter the desired label for the X–Axis or a C/R for the default label.

### 3.7.2 Y–Axis Label

Next, the program asks:

*Enter Y axis label*
*Default = Your Y Label*

The Y label from Line 61 of Setup File will be entered on the line with the "*Default =*" statement the first time through with a new plot. The user should enter the desired label for the Y–Axis or a C/R for the default label.

## 3.8 Titles

Three lines of titles are allowed, and the titles can be at the top or bottom of the plots. The heights of the three lines of titles are in decreasing order from top to bottom. If desired, these heights could easily be modified by changing the values in Lines 15-17 of the Setup File, but the sum of the three must remain unchanged.

The font has already been specified, but great flexibility is available in writing titles. Special text commands can change fonts or alphabets for character strings within the titles; the capability for subscript, superscript, underline, italicize, and Greek characters are also available. The details are in Section 4.7.

The program queries:

*How many header lines do you want?*
*Positive - Above the plot, 3 lines max*
*Negative - Below the plot, 3 lines max*

The reply can be: 0 (no titles); 1, 2, or 3 for the number of lines of titles at the top of the plot; or −1, −2, or −3 for the number of titles below the plot. The Setup File default value for the number of titles is on Line 62.

If the number of lines of titles is not zero, the program asks:

*Enter heading # 1*
*Default =*

The first title should be entered after the above request, and then the above question be repeated until all the titles requested have been entered.

As would be expected, the Setup File has no provision for plot titles.

## 3.9 Legend

### 3.9.1 Legend Labels

The legend provides the capability to associate the line, symbol, and color type with a brief description of the data represented by the curve. This is done for every curve in a box called a "legend".

The font has already been specified, but great flexibility is available in writing legend labels. Special text commands can change fonts or alphabets for character strings within the label; the capability for subscript, superscript, underline, italicize, and Greek characters are also available. The details are in Section 4.7.

A legend is not needed if there is only one curve. The title or an additional label should describe the plot (see Section 3.10). The following message is displayed to let the user know why the Legend option is being skipped: *Legend will not be supplied when you are only plotting one curve.* Otherwise, the program will ask:

*Do you want a legend?*
*Enter "T" for a legend with a title.*

Enter a "Y" for a legend, a "T" for a legend with a title, an "N" to skip this option, or only a C/R for the default setting. The default for this option is on Line 63 of the Setup File.

If a "T" is entered, the program will ask:

*Enter legend title.*
*Default =*

The title for the legend is entered next. The default legend title is on Line 64 of the Setup File.

If a legend is requested, the program will ask the user to enter an identifying label for each curve. A file counter and the file name for the first file will be listed. After that, all blocks and curves will be identified. When that is completed, the file counter is advanced and the second file name listed if it has been specified. This is continued until all files have been listed.

In the example below, two files are being plotted—the first file is plotting two blocks with three curves in each block, and the second file only plots one block with two curves. The following messages would be provided to the user who would be expected to enter a brief legend describing the data after each *Enter legend label...* statement.

*From File number 1, : Data File Name YOURFILE1.DAT*

*Enter legend label for block = 1, curve = 1*

*Enter legend label for block = 1, curve = 2*

*Enter legend label for block = 1, curve = 3*

*Enter legend label for block = 2, curve = 1*

*Enter legend label for block = 2, curve = 2*

*Enter legend label for block = 2, curve = 3*

*From File number 2, : Data File Name YOURFILE2.DAT*

*Enter legend label for block = 1, curve = 1*

*Enter legend label for block = 1, curve = 2*

The number associated with the block is simply a counter for the blocks being plotted in the order they were requested by the user. It is not the number defining its location within the file. In a similar manner, the number associated with the curve is a counter—not related to the column position—of the curves in the order they were defined by the user.

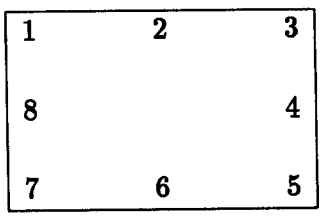
Sometimes, there are more curves to plot than there are unique identifiers. If a user has only requested lines or symbols there are only eight unique lines or nine symbols (default value). Curves beyond that number will begin to repeat the same symbols but will not be identified in the legend. This situation has been discussed earlier in choosing lines or symbols only (Section 3.3.2). The user will be informed of each curve assigned to an identifier that was previously used. To illustrate the message displayed, assume that a file is to be plotted with four blocks and three curves in each block. If the curves are defined by lines only, the first eight would be identified and the user would enter the label for each. The remaining curves would be identified as:

*For Block = 3 and curve = 3, the curve identification ( 10)*
*has already been used in Block 1*
*For Block = 4 and curve = 1, the curve identification ( 20)*
*has already been used in Block 1*
*For Block = 4 and curve = 2, the curve identification ( 30)*
*has already been used in Block 1*
*For Block = 4 and curve = 3, the curve identification ( 40)*
*has already been used in Block 2*

### 3.9.2 Legend Location

The user has complete freedom in choosing where to place the legend. The program wants to know:

*Where do you want the legend located?* **(1)**




*Enter a negative value for the Legend Location Number to be able to specify the X-Y coordinates of a corner or side of the Legend.*

The above drawing identifies eight predetermined regions on the plot where the legend can be located. The default value listed with the question is selected by the program by searching the data to decide which of the eight regions contains the smallest number of data points. The user can position the legend in one of these regions by entering the number of that region as a positive number.

If none of the predetermined legend locations is satisfactory, the user can specify the exact location of the legend frame by entering the X-Y coordinates of either a corner or the center of a side of the frame. The procedure is:

1. From Figure 3.1 below, select the corner or side center for which the X-Y coordinate will be entered.
2. Enter one of the values, 1 through 8, as a *negative* number to select the corresponding corner or side.
3. The program responds with *Enter the X and Y coordinates of the legend.*

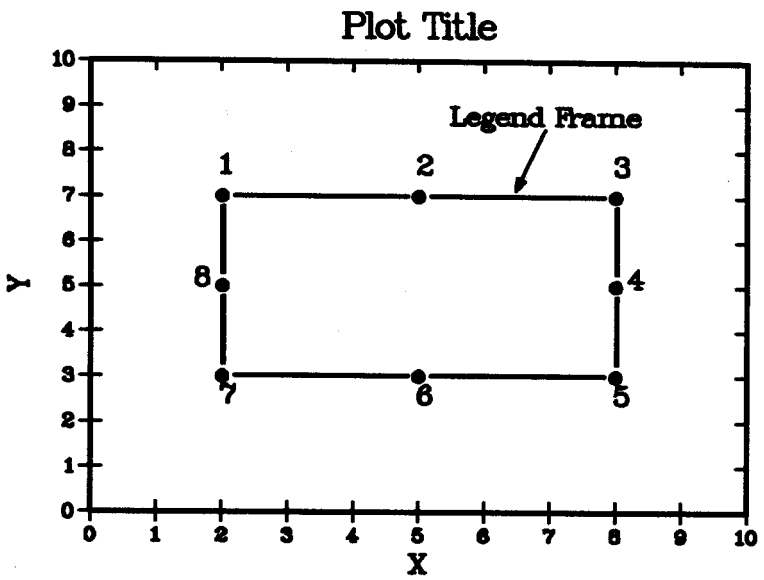



**Figure 3.1. Placing Legend at Desired X–Y Location on Plot**

4. Enter the the X and Y coordinates of the selected corner or side center in plot units. For example, if the plot scales were 0.0 to 100. in X and 0.0 to 50.0 in Y and the option to locate the legend was requested with a $-3$, responding to the coordinate question with "100., 50." would place the legend in the upper right corner of the plot.

## 3.10 Additional Labels with Arrows

Additional labels can be placed anywhere on the plot to add notes to the plot or to provide supplementary information on the curves. The font has already been specified, but great flexibility is available in writing the additional labels. Special text commands can change fonts or alphabets for character strings within the label; the capability for subscript, superscript, underline, italicize, and Greek characters are also available. The details are in Section 4.7.

The program asks:

*Notes or curve identification labels may be placed*
*at any desired location within the plot.*
*How many of these additional labels do you want?*

Entering a zero or C/R will skip this option. Entering a number from 1 to 25 will specify the number of labels which the user wishes to supply. Then the program will ask the following questions as many times as needed to fulfill that request:

*Line 1: Enter text of additional label.*

**Table 3.3. Arrowhead Parameter for Additional Label Arrows**

| Digit 1 | Digit 2 | Digit 3 | Digit 4 |
|---|---|---|---|
| Ratio of Width to Length, 0 to 5 | Size of Arrowhead, 0 to 6 | Form of Arrowhead(s)<br>0= Solid<br>1= White<br>2= Open Lines<br>3= Closed Lines | Location of Arrowhead(s)<br>0= Line Without Arrowhead<br>1= At (X2,Y2)<br>2= At Both Ends, Pointing in Opposite Dir.<br>3= At Both Ends Pointing to (X2,Y2) |

*Line 2: Enter X and Y plot coordinates of the lower-left corner of this label, arrow length (inches), and arrow angle (degrees).*
*Arrow will extend from the:*

| | | | | |
|---|---|---|---|---|
| *Left of Label* | *: Length positive* | *90* | *< angle <* | *270* |
| *Right of Label* | *: Length positive* | *-90* | *< angle <* | *90* |
| *Top of Label* | *: Length negative* | *0* | *< angle <* | *180* |
| *Bottom of Label* | *: Length negative* | *180* | *< angle <* | *360* |
| *No arrow* | *: Length=0* | | | |

Up to 132 characters can be supplied in a label though it is not practical to use that many. The X and Y coordinates of the label and the length and angle of the arrow are entered after the label. The X and Y coordinates are in the plot scale units, the arrow length is in inches and the angle is in degrees. If the arrow is not desired, enter only the X and Y coordinates (arrow will be zero length); otherwise enter four values to specify arrows also. The arrow is drawn from the end or the center of the label as described above to the arrowhead at the specified angle and with the desired length. Figure 5.8 on Page 79 in Section 5.1.6 illustrates these four options for drawing arrows. The Restart File for the plot on Page 80 lists—for each of the four labels—the label location and arrow values with the corresponding title on the following line.

The arrowhead is defined by a four digit number on Line 29 of the Setup File. These digits are described in Table 3.3. The recommended value is 1201. Arrowhead styles and sizes are shown in the VECTOR section of the DISSPLA Users Manual.

## 3.11 Footnote

A footnote written in small letters can be entered at the lower right corner of the plot page. The default for this option is on Line 65 of the Setup File. The following question is asked: *Do you want a footnote?* If a "Y" is entered, then the following request will be made:

*Enter the text of the footnote.*
*Default =*

The user should enter the desired footnote message or a C/R for the default text listed. The default footnote message is on Line 66 of the Setup File.

If the user does not want to see the plot drawn at this time and does not plan to write a Restart File, this is the last opportunity to enter a colon to go directly to the Plot Control Menu.

## 3.12 Plot Drawn

Normally, the plot would be drawn on the terminal screen at this time. If, instead, it is not a multidevice executable and is linked for a hardcopy device, the user will need to wait while plot data are written to FOR077.DAT.

The terminal screen plot will remain on the screen as long as the user needs it. When finished, the user should enter a key (any alphabetic or numeric key) or the space bar. If possible, the C/R should be avoided since it provides two commands (return and line feed) that sometimes causes the next question to be skipped. The VT100, however, requires a C/R after entering a key.

## 3.13 Writing a Restart File

There are a number of options available for writing Restart Files. In all cases, when a Restart File has been requested it will be written quickly with no additional messages and then step to the menu. The following options are available:

- **No Restart File** — If no Restart File has been read in for this session, the program will ask, *Do you want to put the last plot in a Restart file?* If the user replies with a "Y" to indicate that the definition of the present plot file should be written to a Restart File, the program will ask: *Enter the Restart file name.* The user must enter the name to be assigned to this plot definition or a C/R for the default name.
- **Restart File Defined** — If a Restart File has already been read into AEROPLT, two options are available.

(a) *Add to the Restart File* — The program will ask, *Do you want to add the last plot to the Restart file?* The standard procedure is to add any new plot data set to the bottom of the Restart File. The program replaces the last line which is an "N" and a row of asterisks with "Y********....". The "Y" on the last line of the old plot data set will inform the program (when it is read in later to AEROPLT) that another data set follows. Then the new plot data set will be written.

(b) *Write to a New File* — The capability exists to write the new plot data set to a new file—the next version of the file with the same name as the present Restart File. This capability provides the user with the option to write a single data set into a Restart File. Then later these different file versions could be purged or renamed. To implement this option, the user must change the blank or "N" of Line 68 of the Setup File to a "Y", and then the program will list the available options:

*Do you want to write the last plot to a Restart file?* **(FILE.RST)**
*Enter a Y to add to end of present restart file.*
*Enter an N or C/R for No—Do not write to a restart file.*
*Enter a V to write to next version of present restart file name.*

The "Y" or "N" options are the standard options to write to the end of the present Restart File or not write to any Restart File. Replying with a "V" will write the plot data set to the next version of the Restart File name.

## 3.14 Plot Control Menu

Many options are available from the Plot Control Menu. The user can choose one of nine locations within AEROPLT to modify or make additions to the present plot. In addition, the user can obtain screen plots, write to the file for hardcopy plots, read in another or a new Restart File, temporarily exit from AEROPLT and go to the VAX command level ($ prompt), or, when finished, terminate execution of AEROPLT. The Plot Control Menu is presented below.

*Plot Control Menu*
*0: Exit program*
*Another run starting at:* **(1)**
*1: The beginning*
*2: Data files, blocks and columns*
*3: Axes scale limits*
*4: Character fonts*
*5: Axes labels*
*6: Titles*
*7: Legend*

*8: Additional labels*
*9: Footnote*
*10: Write last plot to FOR088.DAT for hardcopy plot.*
—or—
*No option 10. FOR088.DAT written for hardcopy plots of ALL plots.*
*11: Plot from a Restart file.*
*12: Plot again with no changes, then option to save in a Restart File.*
*13: Temporarily exit from AEROPLT to the VAX Command $ Level.*
*Type "LOGOUT" to return to AEROPLT.*

The Plot Control Menu options are discussed in the following paragraphs.

- **Option 0** — A "0" (zero) is entered to exit AEROPLT when plotting is completed. If a plot data set has been written to a Restart File during the session, the following message will be written: *"Restart file written to"* followed by the file name of the last one written. If a hardcopy file was written, the following message is displayed: *"FOR088.DAT written for hard copy plots"*. This is followed by the appropriate message from Table 2.4—depending upon which hardcopy VDI device code was requested. If an executable file is run for a hardcopy device which is not a multidevice, file FOR077.DAT will be listed on the Plot Control Menu (replacing all FOR088.DAT references) and on the output message displayed after entering a "0" Option. File name FOR055.DAT will appear on both these displays when a metafile (device code MET) is requested.
- **Options 1 through 9** — The user who wants to make changes in the present plot enters a number 1 through 9. These nine options in AEROPLT provide the opportunity to return to a specific portion of the program and make the desired changes. The use of the semicolon permits the user to make the new plot as soon as the changes are completed; the use of the colon permits the user to return to this menu as soon as the changes are completed. Some changes a user may want to make may not be listed. Table 3.4 provides a correlation of these nine options and the applicable section in this report. Section 3 of the Table of Contents can be used to locate all questions, and the first option in the table preceeding the desired change can be used.
- **Option 10** — Both statements relating to Option 10 are listed in the Plot Control Menu shown above, but only one would appear in any session. If the user chose to write ALL plots to the hardcopy file, the "No option 10" statement would be listed. However, if hardcopy plots were not being obtained for all plots, Option 10 would allow the user to write to the file for hardcopy plots whenever desired.
- **Option 11** — At any time, whether or not a Restart File has been read in previously, a Restart File can be read in. Many Restart Files can easily be processed during an AEROPLT session.

**Table 3.4. Plot Control Menu Options**

| | Plot Control Menu | Report Section |
|---|---|---|
| 0: | Exit program | |
| | Another run starting at: | |
| 1: | The beginning | 3.3 |
| 2: | Data files, blocks and columns | 3.4 |
| 3: | Axes scale limits | 3.5 |
| 4: | Character fonts | 3.6 |
| 5: | Axes labels | 3.7 |
| 6: | Titles | 3.8 |
| 7: | Legend | 3.9 |
| 8: | Additional labels | 3.10 |
| 9: | Footnote | 3.11 |

Anytime a user is reading in a Restart File, the option is provided to read in only one data set. The following question is asked:

*Enter a C/R to read complete Restart File*

*or Enter integer (i) to process only plot data set number i. Any additions to the Restart File will be placed at the end of the file.*

- **Option 12** — A screen plot can be obtained at any time; however, if an executable which is not a multidevice is being run, the plot file will be written to the applicable terminal or hardcopy device file. After the plot is completed, the option is provided to save the plot data in a Restart File (see Section 3.13).
- **Option 13** — This provides the capability to temporarily go to the VAX command input level (actually, spawn a subprocess at the DCL level) to check on file names, edit a file, or other functions. When finished, the user may return to AEROPLT with "LOGOUT" or just "LOG".

# 4. Advanced Features

The advanced features of AEROPLT, which are discussed in this section, permit the user to choose the symbols, lines, or colors for each of the curves; take advantage of the special text commands in the labels or titles; modify columns of data with special functions; edit the Restart Files instead of making the changes within AEROPLT; or simply access some of the capabilities seldom used.

## 4.1 Data Curve Identification by Customizing

Users can select the symbols, lines, and colors to identify curves instead of letting the program do it. The choice for the Customize Option 4 is introduced in Section 3.3.2. Then, when the program is stepping through the files and blocks (Section 3.4.7) the user can specify the desired identifier for the curves in each block. The following paragraphs discuss how to identify curves.

### 4.1.1 Warning Message

Before getting into the details, however, an unexpected message may appear on the screen. If a user has chosen the Customize Option but has entered a semicolon or colon to branch to the plots or Menu before identifying the data curves (Section 3.4.7), the following message appears:

*You specified CUSTOMIZE and then entered*
*a semicolon or colon. The customize option*
*provides you with the option to choose the*
*identification for each curve. The program*
*will cancel this request to go directly*
*to the plot(;) or menu(:) so you can make*
*this choice. ENTER A C/R WHEN YOU HAVE*
*FINISHED READING THIS.*

This gives the user the opportunity to identify the curves with the the symbols, lines or colors; otherwise, the semicolon or colon may be reentered.

### 4.1.2 Identifying Curves for Black and White Plots

For black and white plots, each curve can be identified by a line, a symbol, or both. The option to thin the plotting of symbols is provided for each curve, but all data points are always used for drawing the line. One Curve Identification Word is used to define the characteristics for plotting one curve.

### a. Lines and Nine Symbols

When the user is not requesting color and has not changed the default number of symbols, the following message appears (see Section 3.4.7) as each block is defined:

| *LINE TYPES* | *PLUS* | *SYMBOL TYPES* |
|---|---|---|
| *0: No Line* | | *0: No Symbol* |
| *10: Solid* | | *1: Box* |
| *20: Dash* | | *2: Up triangle* |
| *30: Dot* | | *3: Circle* |
| *40: Dash - Dot* | | *4: Diamond* |
| *50: Long Dash* | | *5: Down triangle* |
| *60: Broken Line* | | *6: Plus in Circle* |
| *70: Line - 1 Dot* | | *7: Solid Box* |
| *80: Line - 4 Dots* | | *8: Solid Circle* |
| | | *9: X in Box* |

*(ADD): Add the Line type, and Symbol type.*
*(ADD): Add an additional "n x 1000" to plot a Symbol at every n-th data point.*

The thinning rate, line type number, and symbol identifier are combined to provide a Curve Identification Word for each curve. For example, to provide a diamond on every other data point with all the points connected by a dotted line, the Curve Identification Word would be, "2034", where the thinning rate of 2 is multiplied by 1000 and combined with the 30 for the dotted line and 4 for the diamond symbol. A Curve Identification Word must be supplied for each curve plotted within the block. If five curves are to be plotted within a block, a request to thin all symbols by one-fifth, draw a solid line, and plot symbols—solid box, solid circle, diamond, box and circle—the response is, "5017 5018 5014 5011 5013". If no symbol thinning is desired, then the "1000" is not needed; simply enter the values which are to be used, as, "4" for only the diamond symbol.

The actual line types are displayed in the legend in Figure 5.2 on Page 69 and the symbols are displayed in the legend in Figure 5.3 on Page 74.

### b. Lines and 17 Symbols

When the user is not requesting color and has specified the number of symbols in Line 67 of the Setup File, another message appears as each block is defined. The message will not be repeated here since the information is in the "Color, Lines and 17 Symbols" section on Page 52. The color information may be ignored at this time. These instructions follow the table:

*(ADD): Add the Line type, and Symbol type.*

*: Example–Dashed line with * symbol, Add 20 and C: 2C*
*(ADD): Add an additional "n x 1000" to plot a Symbol at every n-th data point*
*: Example–Solid line with X every 5th point: 501E*

The Curve Identification Word is assigned to a curve as discussed previously except that there are 17 choices of symbols. The numbers (1-9) and letters (A-H) are used to select one of the 17 symbols with a single character. The Curve Identification Word, such as the "501E" above, could be considered a number in a base 18 numbering system where the 5000 and the 10 and the E would actually be added. The term adding and combining are both used to describe building the Curve Identification Word.

The actual line types are displayed in the legend in Figure 5.2 on Page 69 and the symbols are displayed in the legend in Figure 5.3 on Page 74.

### 4.1.3 Identifying Curves for Color Plots

Each curve can be identified by assigning a color to a line, a symbol, or both. The option to thin the plotting of symbols is provided for each curve, but all data points are always used for drawing the line. One Curve Identification Word is used to define the characteristics for plotting one curve.

The primary emphasis of this section is to assign colors to the lines and/or symbols used to identify the curves. These colored symbols or lines are the foreground colors. The background color for the plot can be defined by two methods:

- At the time the customize option is assigned (Section 3.3.2), the background color can be selected. Table 3.2 summarizes the three options for background colors. The "4" in the following user responses requests the Customize Option; a "104" requests a black background, a "204" a white background, and a "304" requests a light blue background.
- If the customize option is requested by a "4' and a foreground color is assigned in at least one of the Customize Identification Words (Section 3.4.7), the program will use the background color from Line 54 of the Setup File. If none, a "0", or a "1" is provided in Line 54, the default black background will be used. A "2" will specify white and a "3" the light blue background.

#### a. Color, Lines and 9 Symbols

When the user is requesting color and has not specified a value for the number of symbols in Line 67 of the Setup File, a message appears as each block is defined. The message will not be repeated here since the information is in the next section. One of eight colors can be assigned to a Curve Identification Word to specify the color of the line and/or symbol.Only nine symbols are defined. These instructions follow the information in the table referenced above:

*(ADD): Add the Color, Line type, and Symbol type.*
*(ADD): Add an additional "n x 1000" to plot a Symbol at every n-th data point.*

For example, to plot a red solid box at every other point and connect all data points with a broken line, "2567" should be assigned to that curve.

### b. Color, Lines and 17 Symbols

When the user is requesting color and has specified the number of symbols in Line 67 of the Setup File, a message appears as each block is defined. These instructions follow:

| *color* | *plus* | *line types* | *plus* | *symbol types* | |
|---|---|---|---|---|---|
| *0* | *: No Color* | *0: No Line* | *0: No Symbol* | *A: Plus* | |
| *100* | *: Blue* | *10: Solid* | *1: Box* | *B: Plus in Diamond* | |
| *200* | *: Cyan* | *20: Dash* | *2: Up triangle* | *C: Asterisk* | |
| *300* | *: Green* | *30: Dot* | *3: Circle* | *D: 2 Triangles* | |
| *400* | *: Yellow* | *40: Dash - Dot* | *4: Diamond* | *E: X* | |
| *500* | *: Red* | *50: Long Dash* | *5: Down triangle* | *F: Plus in Box* | |
| *600* | *: Magenta* | *60: Broken Line* | *6: Plus in Circle* | *G: Triangle in Box* | |
| *700* | *: Black* | *70: Line-1 Dot* | *7: Solid Box* | *H: X in Circle* | |
| *800* | *: White* | *80: Line-4 Dots* | *8: Solid Circle* | | |
| | | | *9: X in Box* | | |

*(ADD): Add the Line type, and Symbol type.*
*: Example–Dashed line with * symbol, Add 20 and C: 2C*
*(ADD): Add the Color, Line type, and Symbol type.*
*(ADD): Add an additional "n x 1000" to plot a Symbol at every n-th data point.*
*: Example–Cyan solid line with X every 10th point: 1021E*

## 4.1.4 Simplifying Curve Identification

If many curves are to be plotted, a few things can be done to simplify the task of curve identification when using the Customize Option. When using this option the user often has to enter a long identifier for all the curves to be plotted. This identifier can consist of from one to four characteristics—thinning, color, line type and symbol type. It is often helpful to let AEROPLT provide identifiers as close as possible to the desired ones by using identification Options 0, 1, 2, or 3. Then the option value must be changed to "4" and the curve identifiers modified. There are two ways these changes can be made:

(a) While still within AEROPLT, a "1" can be entered from the Plot Control Menu in order to change to Option 4 when answering the question in Section

3.3.2. Once Option 4 is specified the program will not change these identifiers. When stepping through the curves for each block (Section 3.4.7), the Curve Identification Words will be listed and a C/R can be provided for the correct ones and the desired values can be entered for the others.

(b) A Restart File can be obtained and edited. The curve identification option value should be changed by entering a "4" in Position "4" of the first line of the plot data set. Line Set 5 of the Restart File (see Table 4.1 ) should be edited to provide the correct curve identifiers and Line Set 6 should be edited so those identifiers on the legend agree with the corresponding ones on Set 5.

This procedure to simplify curve identification is illustrated by a plot which requires different line types and different symbols for each curve. Option 3 could be used to cycle through the line types and then the Restart File edited to change to Option 4 and to correct the symbol type for each curve identifier. This procedure would be even more helpful if the symbols needed to be thinned. The Customize Option 4 requires that the thinning rate times 1000 be supplied for all curves. If the thinning rate were supplied (only once) under Option 3, the program would supply the thinning for all curves and only the line type would need to be edited.

## 4.2 Creating Executable Files

AEROPLT normally executes with the multidevice capability of writing to a terminal screen at the same time as writing to a hardcopy file. In some circumstances, however, the multidevice capability does not exist. For classified plotting, drivers of Raster devices, or VAXes without multidevice drivers, separate executables are required for all terminal and hardcopy devices. AEROPLT looks at the name of the executable, and if a valid device name is in positions 8-10 of the name, it will recognize that multidevice capability is not available. For example, an executable linked with device LS5 should be named "AEROPLTLS5".

Files are written to FOR077.DAT for executables linked for a hardcopy device. A copy of AEROPLT.FOR is available in the same directory as the multidevice executable and the Setup File:

**LIBDISK:[1630.1636]AEROPLT.FOR**

The program must be compiled and then linked. Linking for a terminal using device code TK4 is illustrated next:

```
FORTRAN AEROPLT
LINK/EXECUTABLE=AEROPLTTK4 AEROPLT,'LINK_DISS','LINK_TK4'
```

The program locates the device name in position 8-10 of the executable file name and searches the list of terminal and hardcopy device names for a match; if the

device name is located, the program will recognize that only one device has been linked and will not ask the user if all plots are to be written to the hardcopy file (Section 3.1.5). If the device name is located in the list of terminal device codes shown in Table 2.3, the program will provide screen plots as requested and Option 10 (hardcopy plot file) will not be available from the Plot Control Menu. If, on the other hand, the device name is located in the list of hardcopy device codes shown in Table 2.4, then the program will write all plots to the hardcopy FOR077.DAT file and Option 12 (screen plots) will not be available from the Plot Control Menu. If there still is no match, AEROPLT assumes the standard multidevice executable is being run.

## 4.3 Functions of Data

Equations, specified like FORTRAN expressions, can be input to convert units or define a mathematical relationship among columns of data in a file. These functions are entered into AEROPLT after the file and block information have been requested (see Sections 3.4.5 and 3.4.6). When the column numbers for the X and Y variables are requested, a "0" should be entered to request a function; then the program will ask the user to enter a function for each zero provided. Functions recognize the identifying column locations in a data file as C1 for the first column, C2 for the second, and so on. FORTRAN operators and intrinsic functions which can be used in equations are: $+, -, *, /, **, ()$, Sin, Cos, Tan, Exp, Alog, Alog10, Abs. Use "$**$.5" to obtain a square root. Parenthesis can only be used two levels deep "(( ))".

For example, if column 10 were in feet and the plotted quantity in meters, then "0.3048*C10" should be entered.

## 4.4 Modification of Plot Characteristics

The appearance of a plot is the result of numerous choices of text location and letter size, plot borders and legend borders, size and color of plotting symbols and lines, and background color and placement on the page. The authors have provided recommended values for the above characteristics. These default values are supplied in lines 5-27 of the Setup File which is listed in Table 2.5 beginning on Page 18. The user should feel free to experiment with any of these within the limits discussed below. The Line Numbers in the following paragraphs refers to lines within the Setup File.

### 4.4.1 Multiplier

The Multiplier of all dimensions on Line 5 can be used to reduce the entire plot. The character heights and symbol size are controlled by Lines 6 and 7. The symbol

size is doubled for the plot in Figure 5.3 on Page 74.

### 4.4.2 Landscape/Portrait Plot Size

Control over the size and placement of the plot and of the space left for titles is provided by Lines 8-13 for both landscape (Position 50-54) and portrait (Position 55-58) orientations. More information is provided in Section 4.5, Landscape/Portrait Orientation.

### 4.4.3 Text Letter Height

The character height of eight different text strings can be controlled by Lines 14-21. The heights of the three title lines may be modified, but the sum should remain the same unless some other plot characteristic (character heights, page or axis length) were adjusted. The buffer distance may need to be adjusted to match the change in text height. If the height of the legend characters was changed, the buffer distance (Line 25) may also need to be changed.

### 4.4.4 Data Curve Width

Care must be used in setting the data curve line width. When the data are displaying sharp peaks, the value assigned in Line 22 becomes critical. When oscillating data points are very close together, the lines overshoot and introduce spikes not in the data. This problem can be minimized by using a thin line. The recommended default value for Line 22 is 0.001 inch, which usually provides accurate plots. This spike problem is illustrated on Page 78 in Figure 5.6 with a curve width of 0.001 in. and in Figure 5.7 with a width of 0.0125 in. On the other hand, the curves of some plots without spikes may be too light to be seen clearly and this value could be increased to improve the quality of that specific plot.

### 4.4.5 Remaining Plot Control Characteristics

Lines 23-27 provides added control over grid line width, legend, additional labels and the footer.

## 4.5 Landscape/Portrait Orientation

Normally, the user who desires portrait plots should request that the question is asked by entering a "Y" in Position 52 of Line 42 in the Setup File. This provides flexibility; when this question is asked (Section 3.3), the user can produce both portrait and landscape plots within the same session.

### 4.5.1 SETUP.PLT Values

Setup File Lines 8-13 provide values for locating the plot on the page. These values in inches are the X and Y page length, X and Y axis length, and X and Y distance to the origin of the plot on the page. The page length is the size of the total plot including labels and titles; the axis lengths are the lengths of the plot axes; and the distance to the origin places the lower left corner of the plot axes relative to the lower left corner of the page.

The first column of numbers specifies the values for a landscape plot; the second column of numbers, beginning in Position 55, specifies the values for a portrait plot. The user who is not satisfied with the appearance of a landscape or portrait plot can modify these numbers to stretch, shrink, or move the plot on the 8 1/2 by 11 inch sheet of paper.

Though a Restart File will plot landscape or portrait as originally requested, the plot location and size information is not saved in the Restart File.

## 4.6 Restart File

The Restart File saves all the plot characteristics that are required to recreate the plot that was originally drawn at the time the file was written. Note that many of the variables in the Setup File which define characteristics applicable to all plots are not included in the Restart File, but those that are unique to a plot are included. Another good feature of the Restart File—in addition to being able to recreate a plot at a later time—is that it can be edited to modify the plot.

### 4.6.1 Fails When Reading Restart File

The program informs the user if AEROPLT fails to read the Restart File successfully and also provides some information to help find the error. If an extra line were added or deleted in error while editing a Restart File, the program would probably detect the error and inform the user that the Restart File is not in the correct format. The following typical message is displayed:

*********** NOTE ***********
*This Restart file not in the correct format. The program was reading from*
*Line Number 16 of the Restart File when the failure was detected.*
*Reading from this Restart File will be terminated.*
*This Restart File has too MANY/FEW lines of data*
*Ignore this incomplete Restart File. START OVER*

In this example, line number 16 was being read when the failure occurred; but the error could be in an earlier line of the data set. When reading titles and other lines

of text, the program will not detect extra or deleted lines. Normally, the program will not know the number of lines is incorrect until the end of the file is reached or until the correct number of lines has been read without ending at the line of asterisks. If it reads the correct number of lines and asterisks are not found in the last line, the above message will state that the Restart File has too MANY lines of data. If the total number of lines is less than the required number, the above message will state that the Restart File has too FEW lines of data. These tests are correct only when the plot data set which fails is the last or only data set in the Restart File. If a read fails somewhere within the file due to a format error, then neither the *"...too MANY lines..."* nor the *"...too FEW lines..."* message will appear. If the data file name has been read, the plot can be viewed (a "12" from the Plot Control Menu) and possibly the error detected by observing the location of the text messages in the labels, titles, and legend.

If the error in the Restart File can not be determined easily, it is probably better to start over by stepping through the questions. The proper number of labels, titles and legends should be supplied but only brief text messages need to be entered as they can be corrected later by editing from the file which failed.

### 4.6.2 Restart File Contents

The Restart File can be edited to make changes to the plot. Some changes, such as modifying titles, can be done easily. Other changes, such as adding or deleting titles, require knowledge of the flags and counters in the first line of a plot data set and the location of the titles or other lines of information within the set. Involved changes are best made within AEROPLT, but many modifications can be made when the structure of the Restart File is known. Table 4.1 describes the contents of the Restart File.

### 4.6.3 Format for Reading Restart File

The Restart File is written with the format described in the third column of Table 4.1. This same format is used to read Line Sets 1, 15, and 16; all other line sets are read like a list-directed read. The actual position of the variables on the line is not fixed for the majority of the lines, which greatly simplifies modifying the Restart File.

## Table 4.1. Restart File Editing Guide

| Line Set | Columns | Format | Description | FORTRAN Variable |
|---|---|---|---|---|
| 1 | 1 | 1X | Blank | -- |
| | 2 | I1 | Plot Type -- 1: Linear; 2: X Log, Y Linear; 3: X Linear, Y LOG; 4: Log-Log | IGRAF |
| | 3 | A1 | Want whole log cycles for log plots? (Y/N) | QCYCLE |
| | 4 | I1 | Curve Identification -- 0:Symbols only; 1: Lines only; 2: Combination of symbols and lines; 3: Combination of lines and symbols; 4: Customized (Select identification for each curve and thin data.) | IMARKR |
| | 5 | I1 | Grid -- 0:None; 1: Solid; 2: Dashed; 3: Dotted | IGRID |
| | 6 | A1 | Cubic Spline interpolation fit -- Y or N. | QSPLINE |
| | 7-8 | I2 | Number of Header Lines. Maximum = 3. Positive: Above plot. Negative: Below plot. | NTITLE |
| | 9 | A1 | Legend -- Y, N, or T (for legend title). | QLEG |
| | 10-12 | I3 | Total number of legends to identify the curves. | NLEG |
| | 13-15 | I3 | Number of additional labels to describe other plot characteristics. | NADDLAB |
| | 16-17 | I2 | Legend Location -- 1: UL; 2: UC; 3: UR; 4: RM; 5: LR; 6: LC; 7:LL; 8: LM. Neg. to specify position on legend of X-Y coordinates. | ICORNER |
| | 18 | A1 | Footnote desired? Y or N | QFOOT |
| | 19-22 | I4 | Number of files to be plotted. | NFILE |
| | 23-25 | I3 | Which font? (Example, 6 for Triplx) | IFONT |
| | 26-27 | 2X | Blank. | -- |
| | 28-37 | E10.2 | X coordinate of legend corner or side. | XLEGVAL |
| | 38-47 | E10.2 | Y Coordinate of legend corner or side. | YLEGVAL |
| | 48-50 | I3 | Thinning rate for plotting symbols | NTHDATA |
| | 51 | I1 | Background color for color plots (1,2,3 or 4) | ICOLR |
| | 52 | I1 | Landscape: ILAND=1,QLAND=Y. Portrait: ILAND=2,QLAND=N. | ILAND |
| | 53-54 | I2 | Number of symbols to plot (if 0, default of 9) | NOSYM3 |
| | ---------- | | LINE SET 2: X SCALE PLOT LIMITS ---------- | |
| 2 | 1 | 1X | Blank | -- |
| | 2-13 | E12.4 | X minimum plot scale value | XMINF |
| | 14-25 | E12.4 | X maximum plot scale value | XMAXF |
| | 26-37 | E12.4 | X step value between grid lines | XSTEP |
| | 38 | 1X | Blank | -- |
| | 39-41 | I3 | Number of tick mark intervals per X step. | IXTICK |
| | 42-44 | I3 | Log plots, set to -9 for one grid line/cycle. | IXGRID |

Table 4.1 (Continued)

| Line Set | Columns | Format | Description | FORTRAN Variable |
|---|---|---|---|---|
| | ---------- | | LINE SET 3: Y SCALE PLOT LIMITS ---------- | |
| 3 | 1 | 1X | Blank | -- |
| | 2-13 | E12.4 | Y minimum plot scale value | YMINF |
| | 14-25 | E12.4 | Y maximum plot scale value | YMAXF |
| | 26-37 | E12.4 | Y step value between grid lines | YSTEP |
| | 38 | 1X | Blank | -- |
| | 39-41 | I3 | Number of tick mark intervals per Y step. | IYTICK |
| | 42-44 | I3 | Log plots, set to -9 for one grid line/cycle. | IYGRID |
| | ---------- | | LINE SET 4: STEP THROUGH 4A-4C NFILE TIMES ---------- | |
| 4A | 1 | 1X | Blank. | -- |
| | 2-132 | A | Data file name. | FNAME(I) |
| | ---------- | | CAUTION: Editing Line Set 4B,4C NOT recommended. | |
| | ---------- | | Use Plot Control Menu in AEROPLT to make changes. | |
| 4B | 1 | 1X | Blank | -- |
| | 2-5 | I4 | Number blocks to plot from file. | NBLOCK(I) |
| | ---------- | | LINE SET 4C: STEP THROUGH 4C1-4C2 NBLOCK TIMES | ------- |
| | ---------- | | (ONCE OR NUMBER-OF-BLOCKS TIMES IF NOT SIMILAR) | ------- |
| 4C1 | 1 | 1X | Blank | -- |
| | 2-5 | I4 | Number of blocks in the file. | NBKFILE(I) |
| | 6-9 | I4 | Number of the block to plot. | NBLOCKF(I) |
| | 10-13 | I4 | If similar, list number of all NBLOCK blocks | NBLOCKF(I) |
| | etc | I4 | (Actual column position depends on value NBLOCK) | |
| | etc | I4 | Number of curves plotted in each block. | NCURBK(I) |
| | etc | I4 | Data file column containing X variable. | IY(I,0) |
| | etc | I4 | Data file columns containing Y variables. | IY(I,J) |
| | etc | I4 | (Actual column position depends on value NCURBK) | |
| | ---------- | | LINE SET 4C2: STEP THROUGH 4C2 NO. OF TIMES | ------ |
| | ---------- | | FUNCTIONS REQUESTED (ENTERED 0 FOR COLUMN NO.) | ------ |
| 4C2 | 1 | 1X | Blank | -- |
| | | A | Function is listed. | AFUNCT(IYFUNCT(I,J)) |
| | ---------- | | LINE SET 5: CURVE IDENTIFIERS (THINNING,COLOR,LINE,SYMBOL) | |
| 5 | 1 | 1X | Blank | -- |
| | 2-7 | I6 | Curve identification code for thinning,color, and line type for Curve 1. | IMARK(I,J) |
| | 8 | A | Curve identification code for symbol for Curve 1. | CMARK(I,J) |
| | etc | I6,A | Continue codes for all other curves in NCURBK(I) blocks for all NB blocks. | |

Table 4.1 (Continued)

| Line Set | Columns | Format | Description | FORTRAN Variable |
|---|---|---|---|---|
| | ---------- | | LINE SET 5: CURVE IDENTIFIERS ON LEGEND (NLEG>0) | -------- |
| 6 | 1 | 1X | Blank | -- |
| | 2-7 | I6 | Curve identification code for thinning,color, and line type for Curve 1. | LEGMARK(I) |
| | 8 | A | Curve identification code for symbol for Curve 1. | CLGMARK(I) |
| | etc | I6,A | Continue codes for other curves (Total of NLEG). | |
| | ---------- | | LINE SET 7: X AXIS LABEL | -------- |
| 7 | 1 | 1X | Blank. | -- |
| | 2-132 | A | X-axis label. | XLABEL |
| | ---------- | | LINE SET 8: Y AXIS LABEL | -------- |
| 8 | 1 | 1X | Blank. | -- |
| | 2-132 | A | Y-axis label. | YLABEL |
| | ---------- | | LINE SET 9: NTITLE (1 TO 3) LINES OF TITLE | -------- |
| 9 | 1 | 1X | Blank. | -- |
| | 2-132 | A | Text of title line. | TITLE(I) |
| | ---------- | | LINE SET 10: LEGEND TITLE IF QLEG='T' | -------- |
| 10 | 1 | 1X | Blank. | -- |
| | 2-132 | A | Legend title. | LEGTIT |
| | ---------- | | LINE SET 11: TOTAL NLEG LEGENDS (IF NLEG>0) | -------- |
| 11 | 1 | 1X | Blank. | -- |
| | 2-132 | A | Label for curve identifier in legend. | LEGLAB |
| | ---------- | | LINE SET 12: STEP THROUGH 12A AND 12B A TOTAL | -------- |
| | ---------- | | OF NADDLAB ADDITIONAL LABELS IF NADDLAB>0 | -------- |
| 12A | 1 | 1X | Blank. | -- |
| | 2-13 | G12.4 | X coordinate for additional label | XADDLAB(I) |
| | 14-25 | G12.4 | Y coordinate for additional label. | YADDLAB(I) |
| | 26-37 | G12.4 | Arrow Length (zero for no arrow). | ALADLAB(I) |
| | 38-49 | G12.4 | Angle of Arrow in degrees. | AAADLAB(I) |
| 12B | 1 | 1X | Blank. | -- |
| | 2-132 | A | Label (coordinates provided on previous line.) | ADDLAB(I) |
| | ---------- | | LINE SET 13: FOOTNOTE | -------- |
| 13 | 1 | 1X | Blank. (Line Set 13 ignored if QFOOT = N) | -- |
| | 2-132 | A | Footnote text. | FOOT |

Table 4.1 (Continued)

| Line Set | Columns | Format | Description | FORTRAN Variable |
|---|---|---|---|---|
| | ---------- | | LINE SET 14: COLOR VALUE IF ICOLR=3 | -------- |
| 14 | 1 | 1X | Blank. | -- |
| | 2-5 | I4 | Define Light Blue Background: 207 | MAPPR |
| | ---------- | | LINE SET 15: SPECIFY COLOR TITLE... IF ICOLR>0 | ------- |
| | ---------- | | NORMALLY ALL BLACK OR WHITE DEPENDING ON BACKGROUND | --- |
| | ---------- | | MAY BE MODIFIED TO ANY OF 8 DISSPLA COLORS | ------- |
| 15 | 1 | 1X | Blank. | -- |
| | 2-11 | A4,6X | BLAC/WHIT: Color of plot border,scales,Y Label | LCOLTLE(1) |
| | 12-21 | A4,6X | BLAC/WHIT: Color of X Label | LCOLTLE(2) |
| | 22-31 | A4,6X | BLAC/WHIT: Reserved for future use | LCOLTLE(3) |
| | 32-41 | A4,6X | BLAC/WHIT: Color of Titles | LCOLTLE(4) |
| | 42-51 | A4,6X | BLAC/WHIT: Color of Legend Title | LCOLTLE(5) |
| | 52-61 | A4,6X | BLAC/WHIT: Color of Legend | LCOLTLE(6) |
| | 62-71 | A4,6X | BLAC/WHIT: Color of Additional Labels | LCOLTLE(7) |
| | 72-81 | A4,6X | BLAC/WHIT: Color of Footnote | LCOLTLE(8) |
| | 82-91 | A4,6X | BLAC/WHIT: Reserved for future use | LCOLTLE(9) |
| | 92-101 | A4,6X | BLAC/WHIT: Reserved for future use | LCOLTLE(10) |
| | ---------- | | LINE SET 16: Y/N ASTERISKS, FINAL LINE OF DATA SET | ------ |
| 16 | 1 | 1X | Blank. | -- |
| | 2 | A | Y: An additional restart data set (for another plot) follows. | -- |
| | | | N: End of last restart data set in file. | -- |
| | 3-80 | A | ***** (Asterisks in remainder of line to indicate end of restart data set) | -- |

**Table 4.2. Text Commands, Character Fonts, and Symbols**

| DISSPLA Character Font Styles | | DISSPLA Alphabets | Other Commands |
|---|---|---|---|
| Standard | Shaded | | |
| \cg Cartog | \fa Futura | \d Roman | ^ Superscript |
| \si Simplx | \sf Serif | (Default) | _ Subscript |
| \sc Scmplx | \fn Fashon | \i Italic | \u Underline |
| \cx Complx | \lo Logol | \s Script | \deg Degree symbol |
| \dx Duplx | \sl Swissl | \g Greek | \m0 Infinity |
| \tx Triplx | \sm Swissm | \r Russian | \gp Pi |
| \gc Gothic | \sb Swissb | \m Math | \gq Theta |

## 4.7 Special Text Commands

Titles, labels, and legends are usually written in the character font selected during the Interactive Question and Answer session discussed in Section 3.6; however, character font styles, alphabets, or special commands are easily changed within the same line of text. Most of the commands listed in Table 4.2 are specified with the backslash (\). When a command is to control more than one character, the desired characters should follow within "{ }" brackets. All of the character font styles available within DISSPLA are easily accessed from within AEROPLT. The commands for the standard and shaded styles are listed in the first two columns of Table 4.2. Half of the upper and lower cases for the Roman alphabet for all these styles are shown in Table 4.3. All alphabets in each font style are illustrated in Part B, Sections 22 and 23, of the CA-DISSPLA User's Manual (Version 9.0).

The characters for those alphabets in COMPLX style included within AEROPLT are presented in Figure 4.1—Roman, Italic, Script, Greek, Russian, and Math. Symbols frequently used in equations are available in the Greek and Math alphabets. To obtain a Greek letter, enter a backslash "g" (\ g) followed by the Roman upper or lower case letter located on the same line in Figure 4.1.

Command sets, `Re_{e,\gq}` and `T^{ 4}_{\m0}` will produce, respectively:

$Re_{e,\theta}$ *and* $T^{4}_{\infty}$

**Table 4.3. All Available Character Font Styles for the Roman Alphabet**

## Standard Styles

Cartog ABCDEFGHIJKL abcdefghijkl

Simplx ABCDEFGHIJKL abcdefghijkl

Scmplx ABCDEFGHIJKL abcdefghijkl

Complx ABCDEFGHIJKL abcdefghijkl

Duplx ABCDEFGHIJKL abcdefghijkl

Triplx ABCDEFGHIJKL abcdefghijkl

Gothic 𝔄𝔅ℭ𝔇𝔈𝔉𝔊ℌℑ𝔍𝔎𝔏 𝔞𝔟𝔠𝔡𝔢𝔣𝔤𝔥𝔦𝔧𝔨𝔩

## Shaded Styles

Futura ABCDEFGHIJKL abcdefghijkl

**Serif ABCDEFGHIJKL abcdefghijkl**

**Fashon ABCDEFGHIJKL** abcdefghijkl

**Logol ABCDEFGHIJKL** abcdefghijkl

Swissl ABCDEFGHIJKL abcdefghijkl

**Swissm ABCDEFGHIJKL abcdefghijkl**

**Swissb ABCDEFGHIJKL abcdefghijkl**

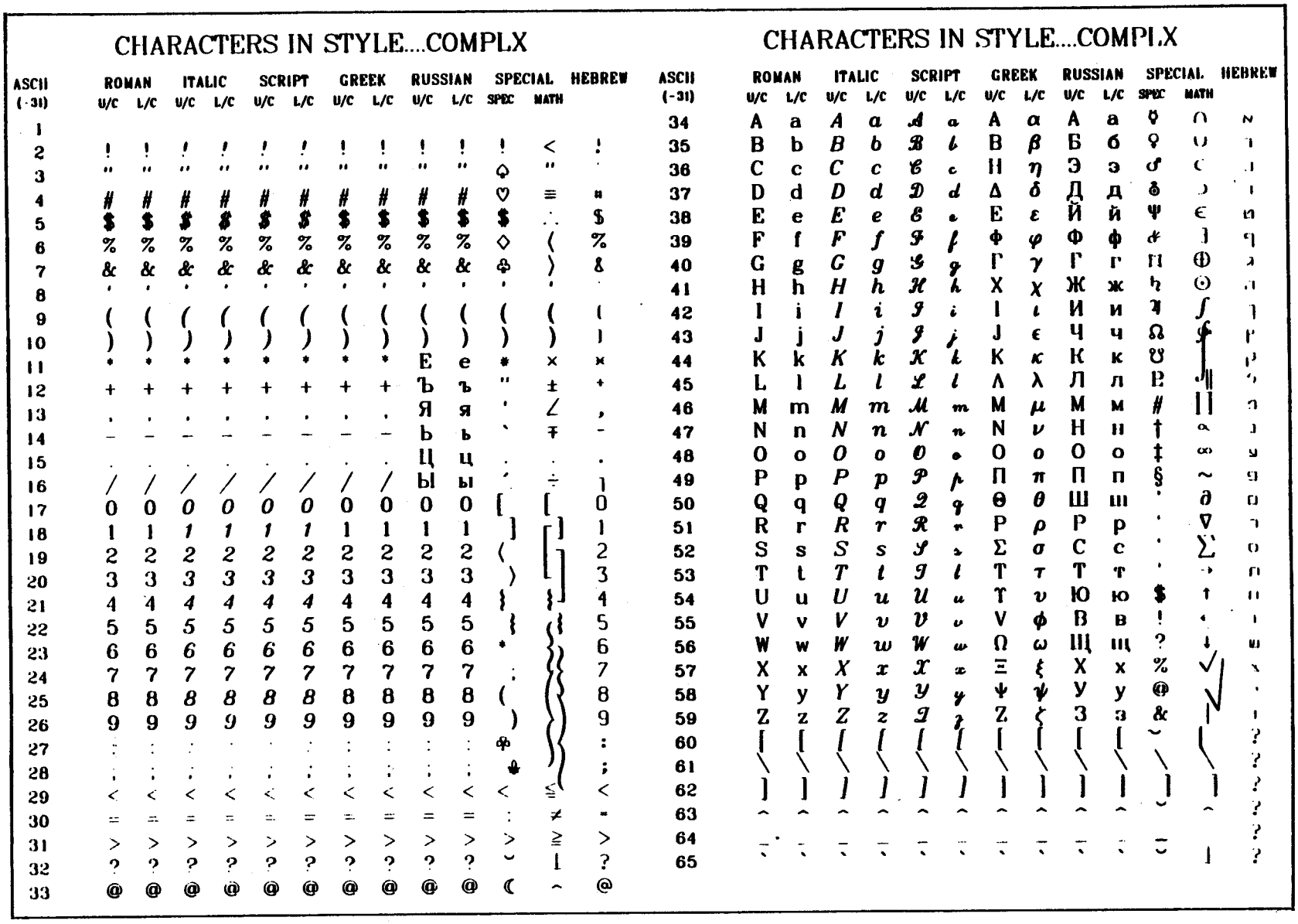



**Figure 4.1. DISSPLA Alphabets Available in AEROPLT, COMPLX Style**
(*CA-DISSPLA User's Manual,* Part B, Figure 22-14, Reprinted with Permission of Computer Associates International, Inc.)

# 5. Sample Plots and Restart Files

A number of plots are presented to illustrate some of the principles and capabilities of AEROPLT. Samples are shown of some cases where data are best identified with lines, some with symbols, and some in color. Cases where color is a distinct advantage are illustrated.

Sometimes a data file must be modified slightly to create new blocks before the desired plots can be obtained. This is illustrated with the first plot. These plots include spline fit, legends, additional labels, special text commands and color. The Restart Files used to generate the plots are also presented.

The first paragraph in the discussion of each plot in this section summarizes the basic features illustrated. The user who wants to implement a new feature in AEROPLT should read these paragraphs and scan the plots to see if the desired feature is described.

## 5.1 Black and White Plots

### 5.1.1 Plotting Blocks

The plot in Figure 5.1 illustrates: 1) Modifying a data file into appropriate blocks to obtain the desired plot, 2) Using additional labels to add information to the plot, 3) Using symbols to locate events on the plot, and 4) Three lines of titles.

The first time the data file, SATEL.DAT, was plotted the output was a meaningless group of curved lines. The original file, which is not reproduced here, was a continuous sequence of lines of data without titles or blank lines. This single block could not be plotted and required modification before meaningful plotting could begin. A portion of the modified file is listed in Table 5.1. The first four lines and the last line are composed of different variables, but the data between the initial line set and the final line are consistent columns of data. The random variables which could not be plotted were placed in different blocks from the column data which could be plotted. One blank line was added after line four and another before the final line of data, so that the data between these two blank lines could be plotted.

The user generating this plot wanted to enter the times of the start and end of the first orbit of this satellite. Four additional labels were added to provide this information. Next, the user wanted to show the location of the beginning and end of each orbit on the curve. The symbol, a box, was added and thinned with a large number so only the beginning and end position of the curve would have the symbol. An additional block was added by entering a blank line in the data after

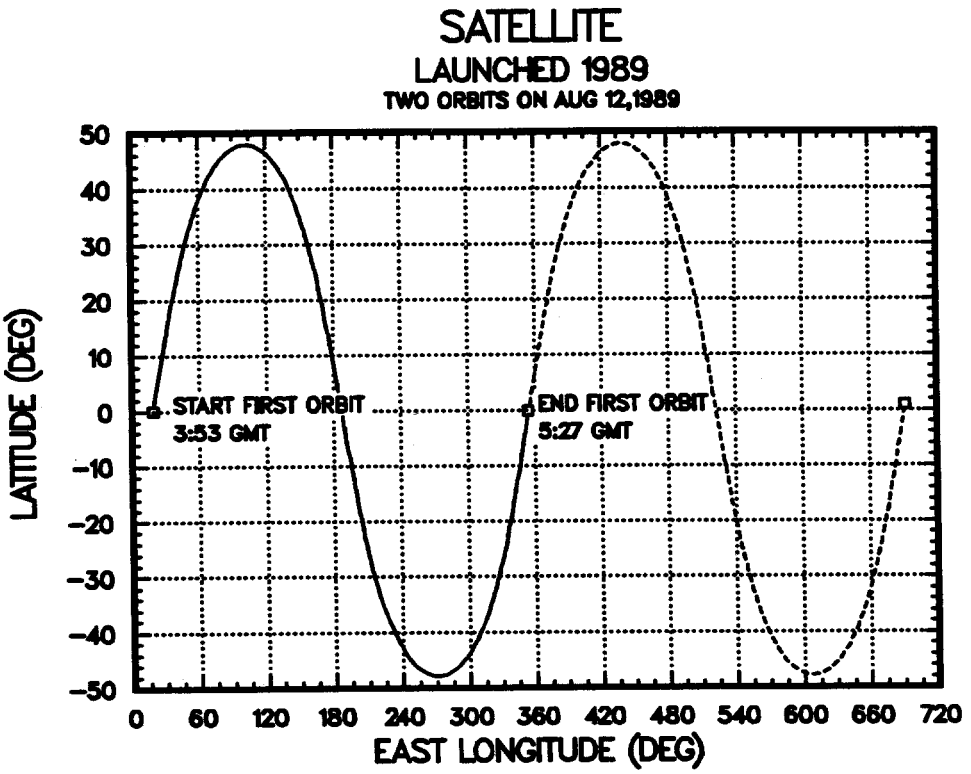



**Figure 5.1. Plotting Blocks**

the end of the first orbit so the second box would be properly placed. A dashed line is used for the second orbit plotted from Block 3. The Restart File, shown in Table 5.2, reveals many details—though the user may need to refer to Section 4.6.2 for a description of the contents of the Restart File. Position 4 of the first line reveals that Option 3, Lines and Symbols, was chosen to identify the data so that the line type would be changed but not the symbol type when moving from Block 2 to Block 3. Line 7 specifies the thinning of 999 for both blocks, the two line types (10 and 20), and the symbol type of 1.

## Table 5.1. Data File for Plot in Figure 5.1

```
   140.0000       30.0000
  15.250040     15.263544      0.000000     -5.173792      4.861310
  89 224.16179092        2447750.5                                    BLOCK 1
       47.7000          37.6376          0.0014          353.7344
                                                                     -------
224  3 52 58.735   18.8749    0.0699   3.1407 -14.6405  37.6321
224  3 57 58.735   30.7480   14.1866   3.6683  -7.0824  12.7173
224  3 58 58.735   33.2661   16.9403   3.7782  -5.6330   8.7671
224  3 59 58.735   35.8646   19.6543   3.8901  -4.2091   5.1001     BLOCK 2
224  4  0 58.735   38.5590   22.3205   4.0041  -2.8132   1.6839
224  4  1 58.735   41.3654   24.9299   4.0239  -1.4477 358.4874
224  4  2 58.735   44.3006   27.4726   3.9385  -0.1157 355.4814
224  4  3 58.735   47.3822   29.9378   3.8504   1.1799 352.6391
224  4  4 58.735   50.6278   32.3134   3.7593   2.4355 349.9363
224  4  5 58.735   54.0554   34.5859   3.6651   3.6474 347.3510
224  4  6 58.735   57.6820   36.7403   3.5675   4.8116 344.8635
224  4  7 58.735   61.5229   38.7605   3.4664   5.9236 342.4558
224  4  8 58.735   65.5904   40.6285   3.3614   6.9783 340.1118
224  4  9 58.735   69.8922   42.3256   3.2525   7.9704 337.8163
224  4 10 58.735   74.4291   43.8319   3.1393   8.8938 335.5557
  .  .  .  .        .         .        .        .       .
  .  .  .  .        .         .        .        .       .
 VALID PLOT DATA REMOVED TO REDUCE SIZE OF LISTING
  .  .  .  .        .         .        .        .       .
  .  .  .  .        .         .        .        .       .
224  5 18 58.735  334.2720  -23.0964   3.0041 -30.5839 100.1860
224  5 19 58.735  336.9986  -20.4453   3.0987 -28.7016  96.1410
224  5 20 58.735  339.6245  -17.7438   3.1939 -26.8390  91.9737
224  5 21 58.735  342.1653  -15.0003   3.2900 -24.9967  87.6915
224  5 22 58.735  344.6358  -12.2226   3.3871 -23.1752  83.3051     BLOCK 2
224  5 23 58.735  347.0502   -9.4179   3.4853 -21.3753  78.8289
224  5 24 58.735  349.4221   -6.5927   3.5847 -19.5979  74.2803
224  5 25 58.735  351.7645   -3.7535   3.6856 -17.8441  69.6792
224  5 26 58.735  354.0903   -0.0000   3.7881 -16.1150  65.0477
                                                                     -------
224  5 26 58.735  354.0903   -0.0000   3.7881 -16.1150  65.0477
224  5 27 58.735  356.4121    1.9425   3.8922 -14.4121  60.4088
224  5 28 58.735  358.7423    4.7873   3.9983 -12.7368  55.7854
224  5 29 58.735  361.0937    7.6219   4.1064 -11.0910  51.1993
224  5 30 58.735  363.4792   10.4401   4.2166  -9.4764  46.6702     BLOCK 3
224  5 31 58.735  365.9120   13.2354   4.3292  -7.8952  42.2152
224  5 32 58.735  368.4058   16.0009   4.4443  -6.3497  37.8482
224  5 33 58.735  370.9751   18.7294   4.5621  -4.8423  33.5796
224  5 34 58.735  373.6350   21.4130   4.6827  -3.3758  29.4162
  .  .  .  .        .         .        .        .       .
  .  .  .  .        .         .        .        .       .
 VALID PLOT DATA REMOVED TO REDUCE SIZE OF LISTING
  .  .  .  .        .         .        .        .       .
  .  .  .  .        .         .        .        .       .
224  6 58 58.735  684.6243   -7.5624   4.2128 -22.6969  89.3330
224  6 59 58.735  686.9754   -4.7273   4.3131 -20.6453  85.5541     BLOCK 3
224  7  0 58.735  689.3054   -1.8823   4.4162 -18.6324  81.7499
224  7  1 58.735  691.6271    0.9667   4.5221 -16.6600  77.9232
                                                                     -------
224.30067981   9.46542590  14.95192699      5.76     19.08           BLOCK 4
```

## Table 5.2. Restart File for Plot in Figure 5.1

```
1Y33N 3N  0  4 1N   1  5    0.00E+00  0.00E+0099901 0
  0.0000E+00  7.2000E+02  6.0000E+01    4   1
 -5.0000E+01  5.0000E+01  1.0000E+01    5   1
SATEL.DAT
   2
   4   2   3   1   5   6
 999011 999021
EAST LONGITUDE (DEG)
LATITUDE (DEG)
SATELLITE
LAUNCHED 1989
TWO ORBITS ON AUG 12,1989
  3.8000E+01  0.0000E+00
START FIRST ORBIT
  3.8000E+01 -5.0000E+00
3:53 GMT
  3.6500E+02 -5.0000E+00
5:27 GMT
  3.6500E+02  0.0000E+00
END FIRST ORBIT
N**********************************************************************
```

### 5.1.2 Line Plots

The features implemented in Figure 5.2 are: 1) Data best identified by lines, 2) Duplicate line types in the Legend, 3) Data functions plotted, 4) Footnote displayed, 5) Legend title shown, 6) Degree symbol, Greek letter and superscript illustrated, and 7) Three lines of titles.

Data in this plot are best identified by lines. If symbols were added, the plot would become too cluttered. The problem with this plot is that there are only eight different line types and ten data curves. Yet, since each data curve, except for the first few, moves lower on the plot in a consistent order, duplicate line types can be used and the data can still be clearly identified. When a user is building this plot, all ten lines are plotted but only eight items are listed in the legend. The need to reuse line types in the legend was considered so rare that no direct method was provided; however, the Restart File can be modified to accomplish this goal. Two data sets for this plot are listed in the Restart File in Table 5.3. The first plot data set was written by AEROPLT with only eight items in the legend. The modified second plot data set was used to generate the plot. Only those users who want to know how to modify the Restart File to add duplicate line types in the legend needs to read the next few paragraphs.

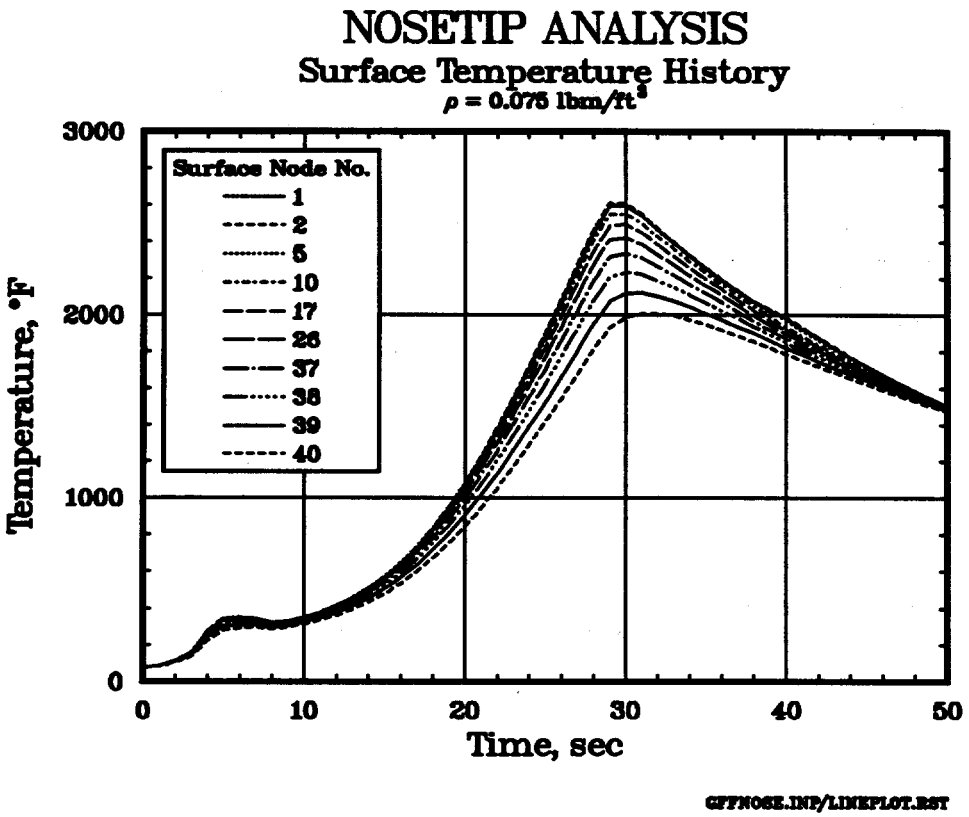



Figure 5.2. Line Plots

## Table 5.3. Restart File for plot in Figure 5.2

```
              (Initial Restart File)
1Y11N 3T   8   0 1Y    1   6     0.00E+00   0.00E+00   101
  0.0000E+00   5.0000E+01   1.0000E+01     5    1
  0.0000E+00   3.0000E+03   1.0000E+03     5    1
GFFNOSE.INP
    1
    1    1   10    1    0    0    0    0    0    0    0    0    0    0
C2-460
C3-460
C4-460
C5-460
C6-460
C7-460
C8-460
C9-460
C10-460
C11-460
    1010    1020    1030    1040    1050    1060    1070    1080    1010    1020
    1010    1020    1030    1040    1050    1060    1070    1080
Time, sec
Temperature, \degF
NOSETIP ANALYSIS
Surface Temperature History
\gr = 0.075 lbm/ft^3
Surface Node No.
1
2
5
10
17
26
37
38
GFFNOSE.INP/LINEPLOT.RST
Y************************************************************
```

## Cont.—Restart File for Figure 5.2

```
                (Modified Restart File)
 1Y11N 3T 10   0 1Y    1  6     0.00E+00  0.00E+00  101
   0.0000E+00  5.0000E+01  1.0000E+01     5   1
   0.0000E+00  3.0000E+03  1.0000E+03     5   1
 GFFNOSE.INP
    1
    1    1  10    1    0    0    0    0    0    0    0    0    0    0
 C2-460
 C3-460
 C4-460
 C5-460
 C6-460
 C7-460
 C8-460
 C9-460
 C10-460
 C11-460
    1010    1020    1030    1040    1050    1060    1070    1080    1010    1020
    1010    1020    1030    1040    1050    1060    1070    1080    1010    1020
 Time, sec
 Temperature, \degF
 NOSETIP ANALYSIS
 Surface Temperature History
 \gr = 0.075 lbm/ft^3
 Surface Node No.
 1
 2
 5
 10
 17
 26
 37
 38
 39
 40
 GFFNOSE.INP/LINEPLOT.RST
 N*********************************************************
```

The Restart File must be edited so that all of the ten data lines are identified in the legend.

(a) Variable NLEG (number of legend items) in Positions 10-12 of the first line of the Restart File in Table 5.3 must be changed from 8 to 10. Two other variables must be changed to be consistent with the new value of NLEG.

(b) Line 17 provides a curve identification for all ten curves. The "1" in the thousand's position shows a thinning rate of one (plot all symbols, if they are requested) and the "10" for the first and ninth curves specifies a solid line. These ten variables specify the eight line types with the first two used again for curves 9 and 10. But Line 18, which specifies the identification in the legend, provides identification for only the first eight curves. Any curve identifier can only be added to the legend the first time it is encountered—any other curve using the same identifier is ignored. So, "1010 1020" must be added to Line 18 to direct the program to allow duplicate line types 10 and 20.

(c) Now that there are ten items in the legend, the labels must be added for the two new items. Two new lines, "39" and "40", must be added after the last label defined, "38",—the third from last line in the first data set.

Data functions are requested on Line 6 of the Restart File by specifying 10 zeros instead of 10 column numbers for the Y variables to be plotted. The 10 functions are listed beginning with "C2−460" which converts the temperature of the Column 2 data from Rankine to Fahrenheit for plotting. The footnote is listed as the last line before the row of asterisks in the Restart File and appears at the lower right below the plot.

### 5.1.3 Symbol Plot

The features implemented in Figure 5.3 are: 1) Data best identified by symbols, 2) All 17 symbols listed in the Legend, 3) Size of symbols doubled, 4) Exact location of legend specified, 5) Partial log-log cycles, and 6) Subscript Greek letters delta and theta illustrated.

This plot, which shows the correlation between the momentum thickness Reynolds Number and the boundary layer thickness Reynolds Number for several test vehicles, illustrates plot data which must be identified by symbols. The legend was placed in the corner to leave as much room as possible for the data point beneath the legend. A value of "−1" was given in response to the question concerning the location of the legend (Section 3.9.2), and the values of Xmin and Ymax (Section 3.5) were used to specify the location of the upper left corner of the legend. These values appear on the first line of the Restart File, Table 5.4.

The Setup File was modified to provide a number of capabilities illustrated by this plot.

- **Plot Symbols** — The program was directed to plot with all 17 symbols by setting Line 67 to 17.
- **Symbol Size** — The size of these symbols was doubled by entering a "2.0" on Line 7 to increase their legibility.
- **Partial Log Cycles** — Line 57 was modified so that the question for partial log cycles would be asked. The use of partial log cycles results in less crowding of the symbols and better utilization of the available space.

**Table 5.4. Restart File for Plot in Figure 5.3**

```
4N40N 0Y 17 0-1N  1 6   2.00E+01 1.60E+03 10117
 2.0000E+01 1.8000E+02 1.0000E+00   1  1
 2.0000E+02 1.6000E+03 1.0000E+00   1  1
TRN.DAT
 17
 17  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17  1  3  6
  1001  1002  1003  1004  1005  1006  1007  1008  1009  100A  100B  100C  100D  100E  100F  100G  100H
  1001  1002  1003  1004  1005  1006  1007  1008  1009  100A  100B  100C  100D  100E  100F  100G  100H
Re'-"gd"
Re'-"gq"
Type 1
Type 2
Type 3
Type 4
Type 5
Type 6
Type 7
Type 8
Type 9
Type 10
Type 11
Type 12
Type 13
Type 14
Type 15
Type 16
Type 17
N**********************************************************************************
```

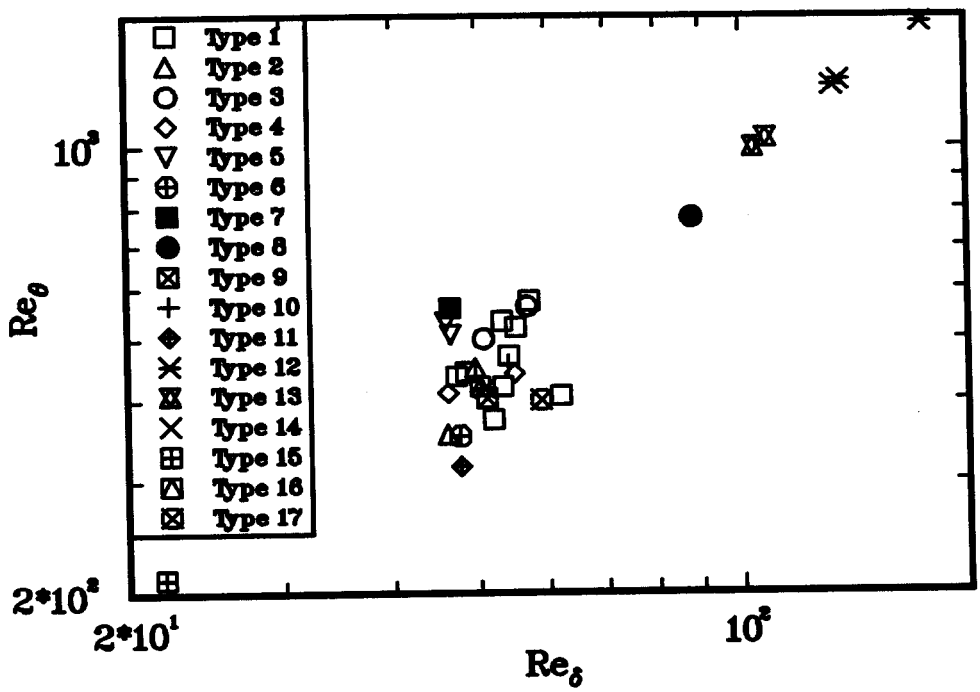



**Figure 5.3. Symbol Plot**

### 5.1.4 Spline Curve

This example implements: 1) The spline fit capability, and 2) The degree symbol.

The plot in Figure 5.4 shows a straight line fit while the curve in Figure 5.5 has a spline fit through the data points. This option is discussed in Section 3.3.5. The Restart File for the plot with the linear lines is in Table 5.5 and the file for the spline curve fit is in Table 5.6. The only difference between these two Restart Files is the variable, QSPLINE ("N" and "Y", respectively), in Position 6 of the first line of each file. In order to implement this option so the user can choose a spline fit, a "Y" must be entered in Position 52 of Line 58 of the Setup File.

**Table 5.5. Restart File for Plot in Figure 5.4**

```
1Y20N 1N  0  1 1N   1  4    0.00E+00  0.00E+00  101 0
  0.0000E+00  1.0000E+01  5.0000E+00    5   1
  0.0000E+00  5.0000E+02  2.5000E+02    5   1
gffnose.inp
   1
   1   1   1   1   0
C2-460
   1011
Time, sec
Temperature, \degF
LINEAR LINE BETWEEN DATA POINTS
  2.0000E+00  2.0000E+02
Surface Node No. 1
N************************************************************
```

**Table 5.6. Restart File for Plot in Figure 5.5**

```
1Y20Y 1N  0  1 1N   1  4    0.00E+00  0.00E+00  101 0
  0.0000E+00  1.0000E+01  5.0000E+00    5   1
  0.0000E+00  5.0000E+02  2.5000E+02    5   1
gffnose.inp
   1
   1   1   1   1   0
C2-460
   1011
Time, sec
Temperature, \degF
SPLINE FITTED DATA
  2.0000E+00  2.0000E+02
Surface Node No. 1
N************************************************************
```

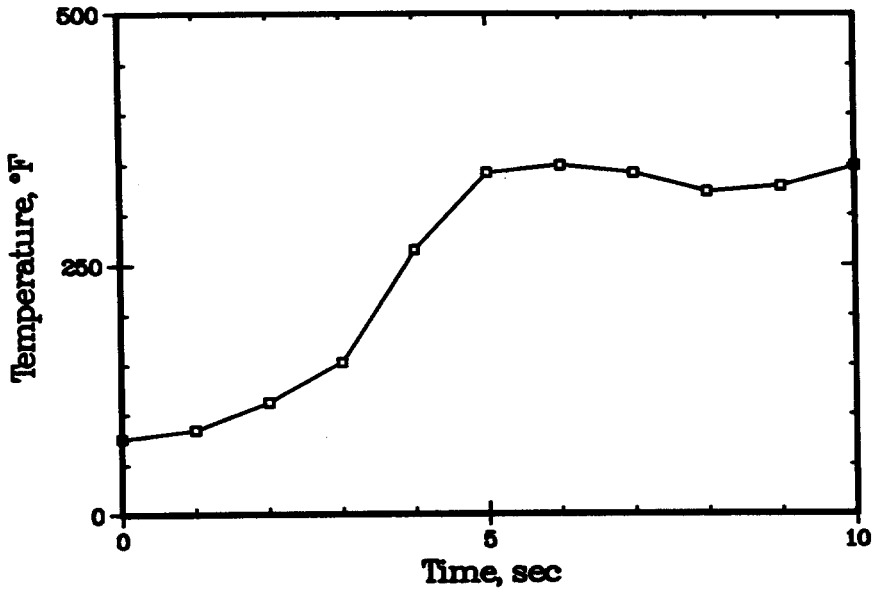



**Figure 5.4. Linear Line Between Data Points**

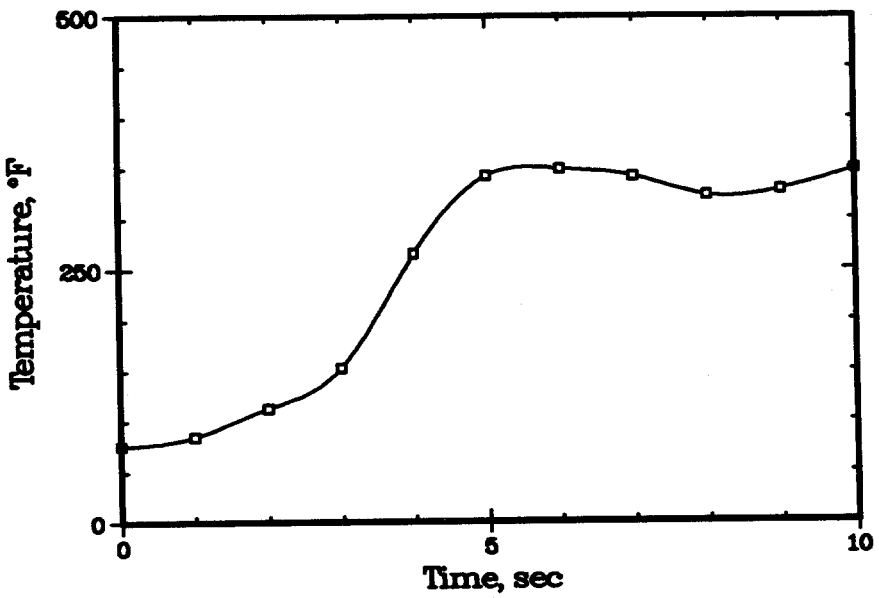



**Figure 5.5. Spline Fitted Data**

### 5.1.5 Data Curve Width

The Advanced Features Section 4.4.4 discusses plotting with different data curve widths. When the data are displaying sharp peaks, the value assigned in Line 22 of the Setup File becomes critical. Plotting these data with a wider line width produces spikes which display values significantly different from those in the tabulated data. This is illustrated by comparing the plots in Figure 5.6 with a curve width of 0.001 in. and Figure 5.7 with a width of 0.0125 in. The large spikes shown in Figure 5.7 are purely artifacts of the line width chosen—they don't represent the data.

The Restart Files are not relevant for this case and are not included; the data curve width is controlled by the Setup File.

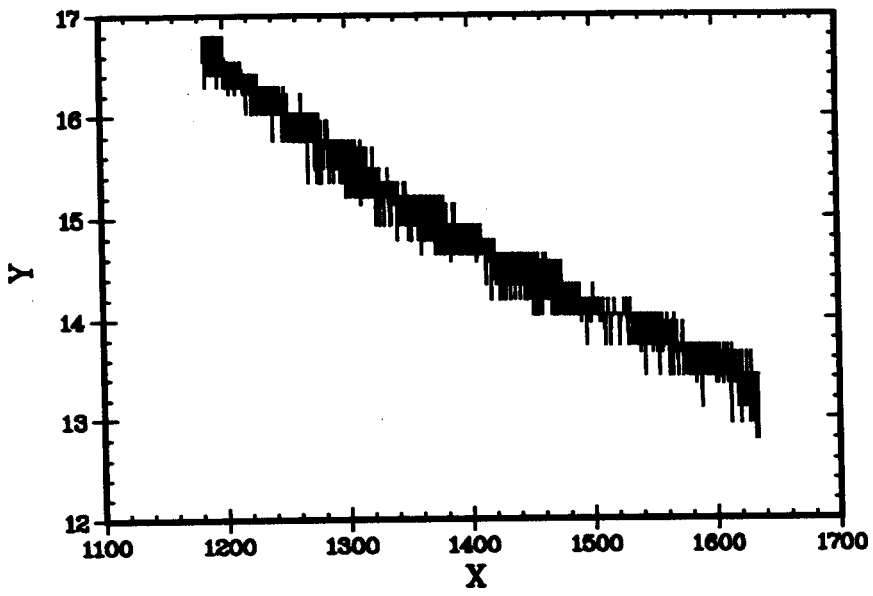



**Figure 5.6. Curve Width of 0.001 in.**

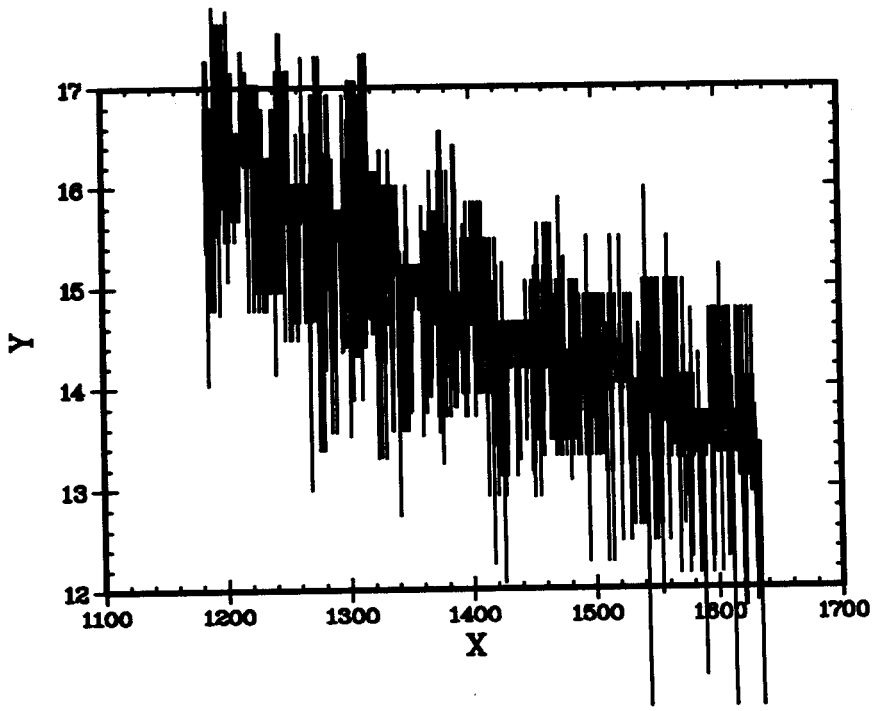



**Figure 5.7. Curve Width of 0.0125 in.**

### 5.1.6 Labels with Arrows

The features implemented in Figure 5.8 are: 1) Identifying plot characteristics with additional labels and arrows, and 2) Titles in script and additional labels in a shaded font style (Swissm).

Arrows can be used with additional labels to identify significant portions of the plot. The options for placing the base of the arrow at either end or in the middle of the top or bottom of the label are discussed in Section 3.10. These four options are illustrated in Figure 5.8 and the input data lines are listed in the Restart File in Table 5.7. The arrows are from the ends of the labels for "CURVE 1" and "CURVE 4" (positive length and the arrows are over 90 degrees and less than 90 degrees, respectively). Arrows are from the middle top of the label for "CURVE 2" (negative length and the arrow is between zero and 180 degrees) and the bottom of "CURVE 3" (negative length and the arrow is between 180 and 360 degrees). It should be noted that the user enters the text of the additional label before the coordinates and arrow information; the text follows the coordinates and arrow information in the Restart File.

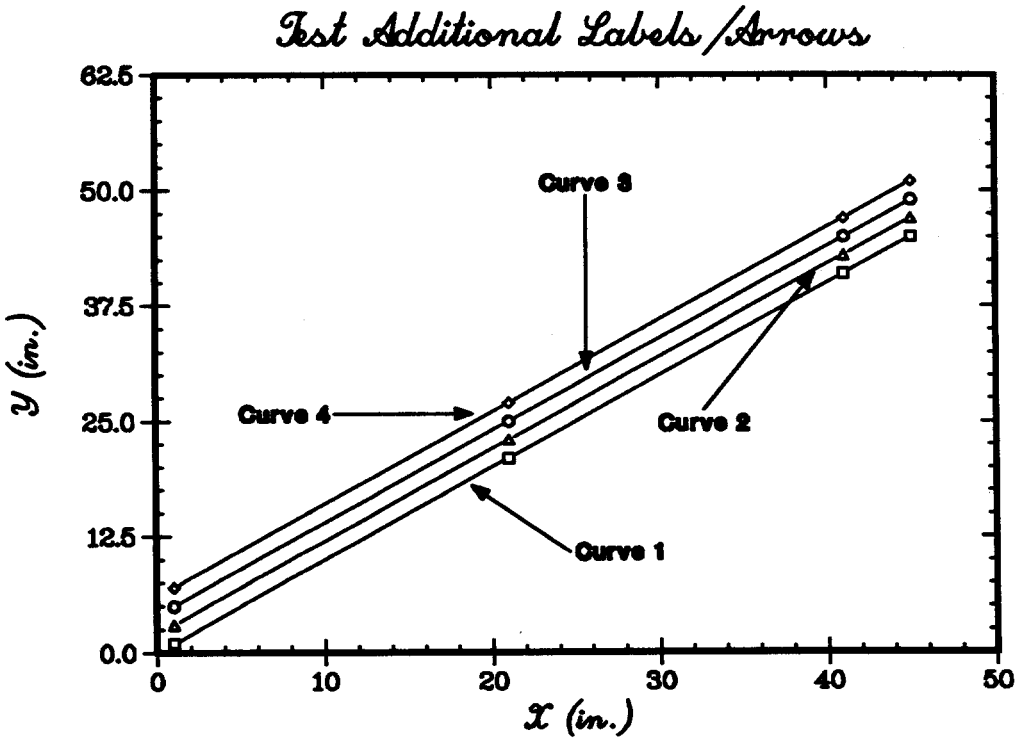



**Figure 5.8. Additional Labels with Arrows**

## Table 5.7. Restart File for Figure 5.8

```
1Y20N 1N  0  4 1N   1  4    0.00E+00  0.00E+00  501 0
  0.0000E+00  5.0000E+01  1.0000E+01    5   1
  0.0000E+00  6.2500E+01  1.2500E+01    5   1
FOR001.DAT
   4
   8   1   2   3   4   1   1   2
   5011   5012   5013   5014
\s{X (in.)}
\s{Y (in.)}
\s{Test Additional Labels/Arrows}
   25.00       10.00       1.000       145.0
\sm{Curve 1}
   30.00       24.00      -1.500       52.00
\sm{Curve 2}
   23.00       50.00      -1.500       270.0
\sm{Curve 3}
   5.000       25.00       1.150      0.0000E+00
\sm{Curve 4}
N*****************************************************
```

## 5.2 Color Plots

Color plots always complement a presentation or a report, though it is not always practical to include them. Some color plots, though visually appealing, do not represent any practical improvement over black and white plots. The two plots discussed in this section show the clear advantage which some color plots have over black and white.

### 5.2.1 Color Symbol Plot

The features implemented in Figure 5.9 are: 1) Data best identified by symbols, 2) Additional information provided by color, 3) Light blue background color, 4) Exact location of legend specified, 5) Partial log-log cycles, and 6) Subscript Greek letter theta illustrated.

The discussion in Section 5.1.3 should be referenced for all features except the second and third. Additional information is added to the plot in Figure 5.3 through the use of color. Data for the same vehicle use the same symbol with different colors representing different vehicle models. For example, Vehicle 3 is plotted with a solid circle and the blue, yellow and red colors display data for Models A, B, and C. Color provides a convenient and easily read method for extracting the vehicle and model information from the plot.

The light blue background allows more foreground colors than either black or white—both white and black symbols are used. The Restart File for this plot is in Table 5.8.

**Table 5.8. Restart File for Color Plot in Figure 5.9**

```
4N40N 0Y 17 0-1N  1 6   2.00E+01 1.60E+03 13117
 2.0000E+01 1.8000E+02 1.0000E+00   1  1
 2.0000E+02 1.6000E+03 1.0000E+00   1  1
TRN.DAT
 17
 17  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17  1  3  6
   107  407  802  108  408  508  104  504  609  209  506  40D  10D  60G  70G  40H  10C
   107  407  802  108  408  508  104  504  609  209  506  40D  10D  60G  70G  40H  10C
Re'-"gd"
Re'-"gq"
Vehicle 1/Mod A
Vehicle 1/Mod B
Vehicle 2
Vehicle 3/Mod A
Vehicle 3/Mod B
Vehicle 3/Mod C
Vehicle 4/Mod A
Vehicle 4/Mod B
Vehicle 5/Mod A
Vehicle 5/Mod B
Vehicle 6
Vehicle 7/Mod A
Vehicle 7/Mod B
Vehicle 8/Mod A
Vehicle 8/Mod B
Vehicle 9
Vehicle 10
207
  BLAC   BLAC   BLAC   BLAC   BLAC   BLAC   BLAC   BLAC   BLAC   BLAC
N**********************************************************************
```

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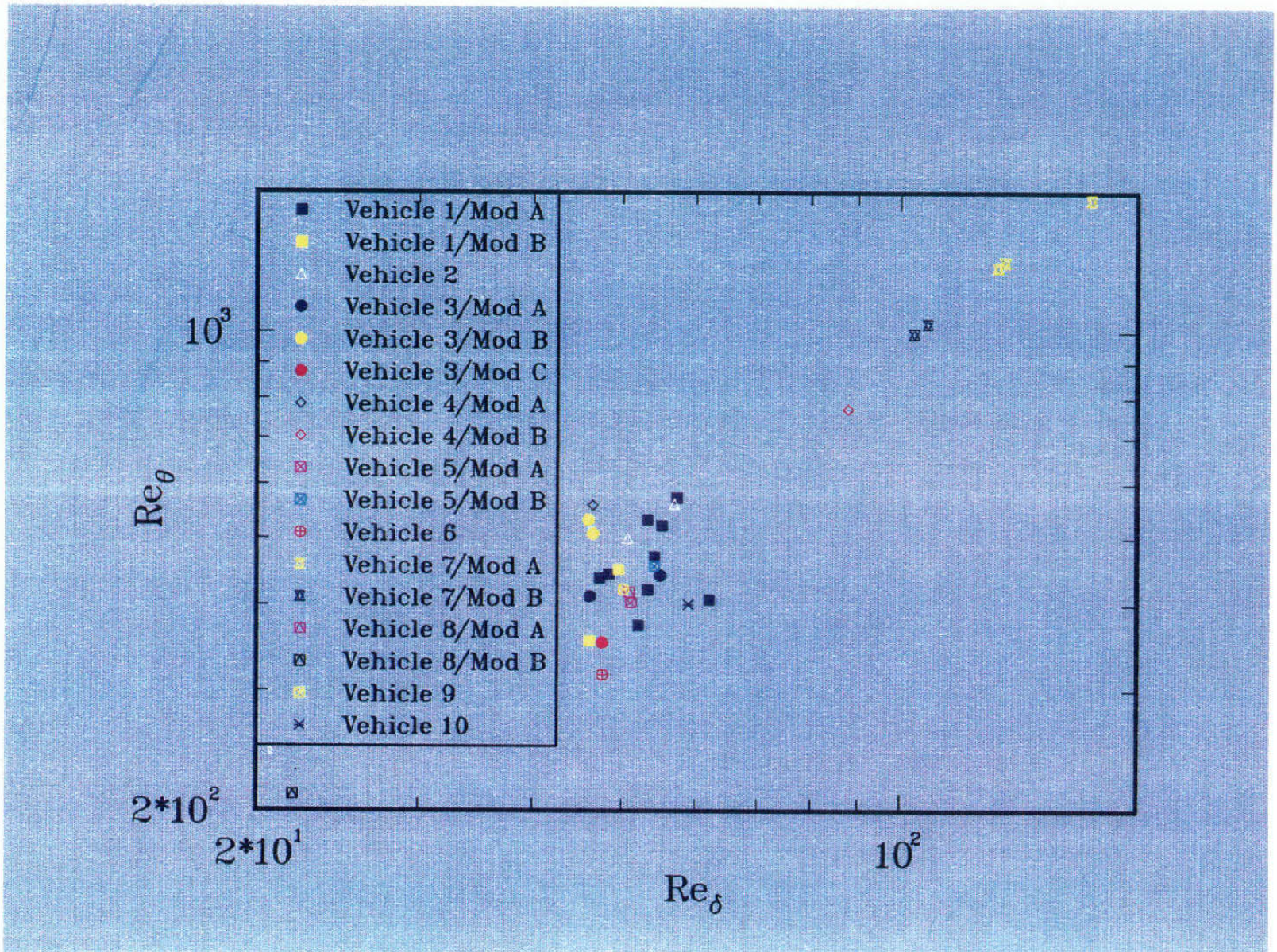


**Figure 5.9. Color Symbol Plot**

### 5.2.2 Overlaid Data Plot

The features implemented in Figure 5.10 are: 1) Display of overlaid data curves by contrasting colors and 2) Colors of titles, borders, and legends specified by user.

The advantage of color in revealing the location of the three data lines which significantly overlay one another is very apparent. The choice of foreground colors for the data curves is easily implemented by choosing the Color Option (Section 3.1.4) and the Customize Option (Sections 3.3.2, 3.4.7, and 4.1). The user can specify the colors of titles, borders, and legends by modifying the list of colors in the next to last line of the appropriate Restart File (see Table 5.9). The program outputs this line as a series of foreground colors which are all white or all black; this line of data can be modified by using any of the eight DISSPLA colors—entering only the first four characters of each name. The colors of the title, border, and legend which these words control are described in Line Set 15 in Table 4.1 on Page 58.

**Table 5.9. Restart File for Color Plot in Figure 5.10**

```
1Y40N 1Y  3  0 3N   3  6   0.00E+00  0.00E+00  121 0
  1.1000E+01  2.0000E+01  1.0000E+00    5   1
  0.0000E+00  4.0000E+02  5.0000E+01    5   1
A4:[SGBEARD.S4525DFD]HW6G1120.TFD
   1
   1   1   1   1   2
 A4:[SGBEARD.S4525DFD]SUSNF1ND1.INV
   1
   1   1   1   1   3
 A4:[SGBEARD.S4525DFD]S6GNOSMO4.INV
   1
   1   1   1   1   3
    110    510    310
    110    510    310
Time (sec)
Heat Transfer Rate (Btu/ft^2-sec)
NO SMOOTHING OF SURFACE TEMP.
Data
Computed, NFT=1
Computed, NFT=3
   BLUE     BLUE     BLUE     BLUE     BLUE     BLUE     BLUE     BLUE     BLUE     BLUE
N**************************************************************************************
```

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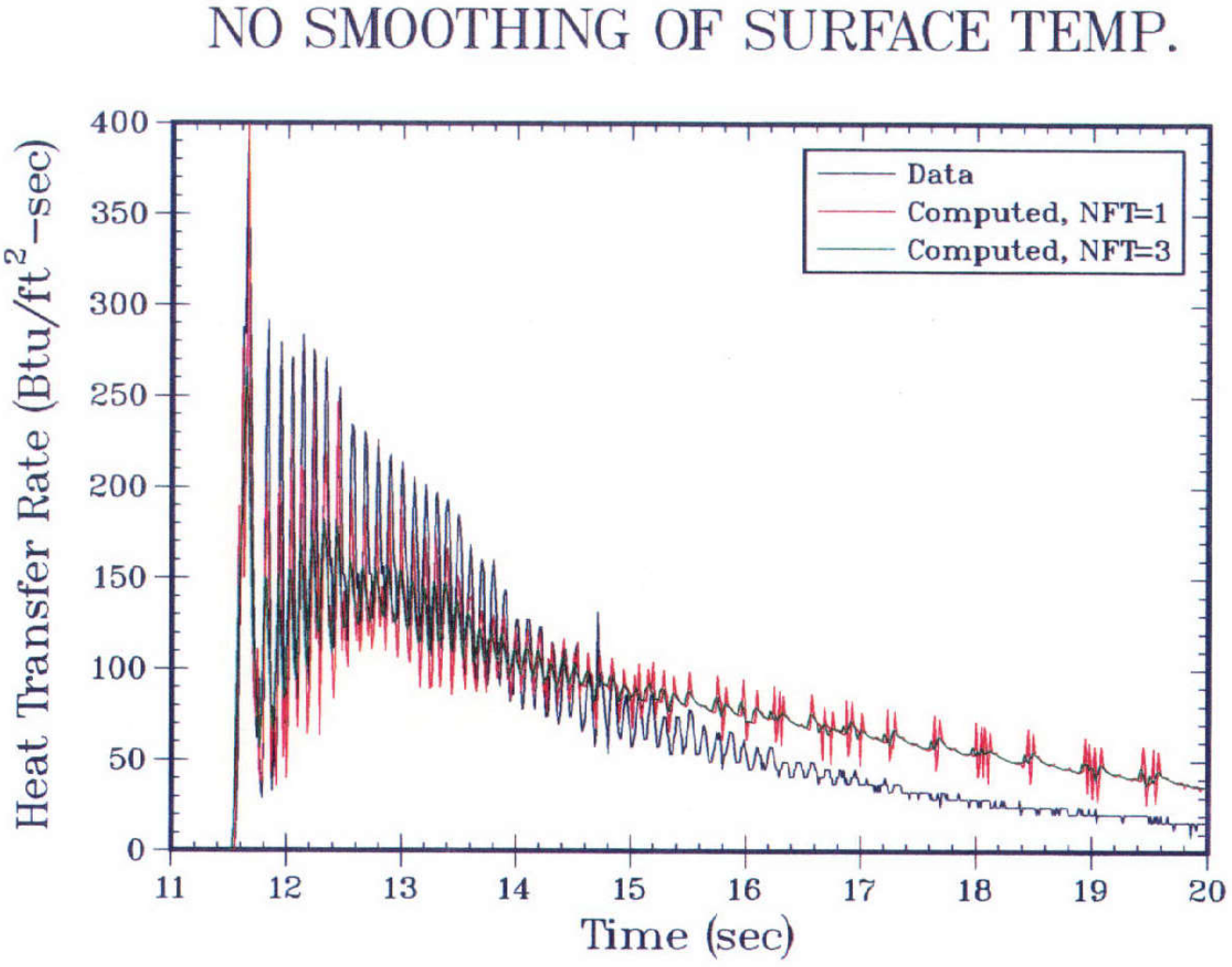


**Figure 5.10. Overlaid Data Plot**

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1510 J. W. Nunziato
1511 D. K. Gartling (12)
1512 J. C. Cummings (18)
1513 D. W. Larson (2)
1513 R. E. Hogan
1513 V. F. Nicolette
1520 L. W. Davison
1521 L. W. Davison, actg.
1522 R. C. Reuter, Jr.
1522 C. R. Adams
1523 J. H. Biffle
1523 T. D. Blacker
1524 D. R. Martinez
1524 C. R. Dohrmann
1530 W. Herrmann, actg.
1531 S. L. Thompson
1533 P. Yarrington
1534 J. R. Asay
1550 C. W. Peterson
1551 J. K. Cole (10)
1552 D. D. McBride (16)
1553 W. L. Hermina (11)
1554 D. P. Aeschliman (13)
1555 W. R. Barton (13)
1556 W. L. Oberkampf (15)
1556 D. E. Larson (20)
1820 J. B. Woodard
2140 J. B. Woodard Jr.
2530 G. M. Ferguson
2630 W. F. Mason
2634 S. K. Fletcher
2634 J. F. Mareda
2635 R. E. Jones
2640 E. J. Theriot
5160 G. R. Otey
5240 D. S. Miyoshi
5260 J. R. Kelsey
6210 B. W. Marshall
6220 D. G. Schueler
6225 H. M. Dodd
6225 M. A. Rumsey (8)
6225 P. S. Veers
6230 V. L. Dugan, Act.
6340 W. D. Weart
6410 D. A. Dahlgren
6420 W. B. Gauster
7233 R. E. Smith
7233 M. K. Fuentes (5)
7520 T. J. Hoban
7522 J. P. Biedscheid
7530 T. L. Workman
7537 N. R. Keltner
7540 T. B. Lane
7550 R. A. David
8160 D. J. Bohrer
8230 W. D. Wilson
8240 C. W. Robinson
8350 J. S. Binkley
8360 W. J. McLean
8524 J. A. Wackerly
9010 W. C. Hines
9011 T. D. Woodall
9012 R. B. Heath
9014 M. L. Bunting
9015 J. W. Purvis
9110 C. W. Childers
9113 D. F. Wolf
9114 E. A. Walther
9120 M. M. Newsom
9130 R. D. Andreas
9141 M. W. Sterk
9142 A. C. Bustamante
9142 J. J. Bertin
9142 B. M. Bulmer
9143 E. W. Reece
9143 D. N. Benton
9144 W. E. Williamson
9144 S. A. Kerr

9144 B. A. Rainwater
9145 A. K. Miller
3141 S. A. Landenberger (5)
3141-1 C. L. Ward (8) for DOE/OSTI
3151 W. L. Klein (3)

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| Org. | Bldg. | Name | Rec'd by | Org. | Bldg. | Name | Rec'd by |
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| ~~8524~~ | | ~~Wackerly~~ | | | | | |
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